NMS CAS for Natural Call Control Developer's Manual

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NMS COMMUNICATIONS

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1 Introduction

The *NMS CAS for Natural Call Control Developer's Manual* describes how to install and run NMS channel associated signaling (CAS) protocol software with the Natural Call Control (NCC) service. This manual is for developers of telephony and voice applications who are using Natural Access. This document defines telephony terms where applicable, but assumes that you are familiar with telephony concepts and switching, and the C programming language.

2 Overview of NMS CAS

PSTN trunk interfaces

Analog trunks with loop start signaling are the most common type of telephone trunks found in residential installations. The network uses the presence or absence of current flow in the telephone circuit as signaling information when establishing and processing connections.

Digital trunks multiplex the signal of many different channels into one interface. Digital trunks follow two basic standards around the world:

- T1 trunk lines have a capacity of 1.544 Mbps, and typically handle 24 simultaneous telephone channels. T1 trunks are used in the United States, Canada, Hong Kong, and Japan.
- E1 trunk lines have a capacity of 2.048 Mbps and typically handle 30 simultaneous telephone channels. E1 trunks are used mainly in Europe, Asia, and South America.

Digital trunks use signaling bits associated with voice channels to carry signaling information. For a detailed description of T1 and E1 communications, see the appropriate board installation and developer's manual.

Trunk interface boards and the CT bus

NMS trunk interface boards can connect to other boards in the same chassis over the CT bus. The CT bus is a high-speed, time-division multiplexed digital telephony bus between telephone line interface boards (such as AG 2000 boards), that allows boards to share data, signaling, and switching information. You can add additional DSP resources, analog line interfaces, or loop start line interfaces, by using other AG 2000 boards or board sets.

You can also use MVIP-compatible products from other manufacturers with NMS boards.

For detailed information about a particular NMS board, refer to the appropriate board installation manual.

Warning:	NMS obtains board-level approval certificates for supported countries. Some countries require you to obtain system-level approvals before connecting a system to the public telephone network. To learn what approvals you require, contact the appropriate regulatory authority in the target country.

NMS CAS protocols

To communicate across a trunk line, parties must signal one another. The scheme used to signal across a telephone line is called a protocol. Many different protocol standards are in use throughout the world.

The following table describes the NMS CAS protocols:

Protocol	Description
Analog loop start (LPS)	Includes protocols that use loop start signaling, where the presence or absence of current flow is interpreted by a switch as protocol signaling events.
Australian P2 (AP2)	Used in Australia for connections between the PBX and some PSTN carriers. It uses two-bit line signaling (derived from CCITT recommendation Q.421), and in-band DTMF register signaling.
EL7	Implements the application computer variant of the EL7 protocol found on an Ericsson MD110 PBX.
European digital channel associated signaling (EUC)	Includes channel associated signaling protocols used in certain European countries. The protocols use two-bit line signaling specified by national standards for use over E1 trunks. The register signaling is either carried by in-band DTMF tones (not compelled) or by out-of-band decadic pulses.
Feature group D (FGD)	Implements the specifications of the feature group D (FGD) switched access service. This service provides interconnection to the BOC (Bell Operating Companies) network for the provision of message telecommunications service/wide area telecommunications service (MTS/WATS) and MTS/WATS-type services. FGD service, which provides access to the trunk side of suitably equipped BOC switching systems, is available for termination and originating access.
Ground start (GDS)	NMS ground start protocols cover digital interfaces (T1 trunks) connected to a private branch exchange (PBX) or PSTN switches. The protocol can handle two signaling variations: FX (foreign exchange) and SA (special access).
Mercury exchange line (MELCAS)	Implements the Mercury exchange line CAS protocol.
MF-Socotel (MFS)	Conforms to the Spanish National Specifications for channel associated signaling over E1 trunks. It uses single bit steady-state line signaling and MF-Socotel MF compelled in-band register signaling.
Multi-frequency compelled protocols based on the R2 standard (MFC)	Includes the CCITT Signaling System R2 (Recommendations Q.421 to Q.442, CCITT Blue Book, 1988) implementation and numerous national variations. These protocols run on E1 trunks and use two-bit line signaling on the signaling channel associated with each voice channel and in-band MF compelled register signaling.
NEC PBX (NEC)	A digital line interface protocol that implements the specifications of the 30 DLI using the PA-30 DTS package (Annex 303-15-B 2/2 from NEC, NEC Australia PTY, LTD).
Off-premises station (OPS)	The NMS OPS protocol covers only digital interfaces. The protocol can handle T1 or E1 digital trunks, of signaling types FX (foreign exchange) or SA (special access).
Operator workstation (STA)	Other side of the analog loop start protocol used to implement stations that connect to analog phones.
Pulsed E and M (EAM)	Includes country-specific protocols that use one-bit line signaling in a pulsed form, and variations on the compelled in-band MF register signaling specified by the CCITT in the 1988 Blue Book. These protocols run on E1 trunks and are specified in different countries by national regulatory agencies.

Protocol	Description
Signaling system 5 (SS5)	Specified by the CCITT Recommendations Q.140 to Q.154 (CCITT Red Book, Volume VI Fascicle VI.2, Geneva 1985). The protocol uses in-band compelled signal frequency tones to perform line signaling and in-band MF tones for register signaling. Since no signaling bits are used, this protocol works the same way on T1 and E1 trunks.
System R1.5 (R15)	Includes channel associated signaling protocols used for E1 lines in Russia (based on CCITT recommendations Q.511 and Q.544). The protocols use two-bit steady-state line signaling. Register signaling is either carried by in-band MF tones (MF acknowledged pulses) or by out-of-band decadic pulses. Two R15 protocol software modules are included with NMS CAS. One is used (r150) for controlling inbound calls and the other (r151) is used for controlling outbound calls.
Digital and analog wink start (WNK)	Includes protocols used on T1 in the USA, Hong Kong, and Taiwan. The protocol uses one-bit signaling, two-bit signaling, or presence or absence of current, and owes its name to the wink (brief presence of current or variation of the signaling bit) that the inbound side uses to acknowledge line seizure. Register signaling is performed by in-band DTMF or MF tones, or by out-of-band decadic pulses.

Most of the protocols in these families have country-specific variations. NMS provides parameter files that determine how protocols interact with telephone networks in different countries. The package for each country contains software modules you need to download to enable telephony boards to communicate with telephone networks in that country.

NMS CAS software

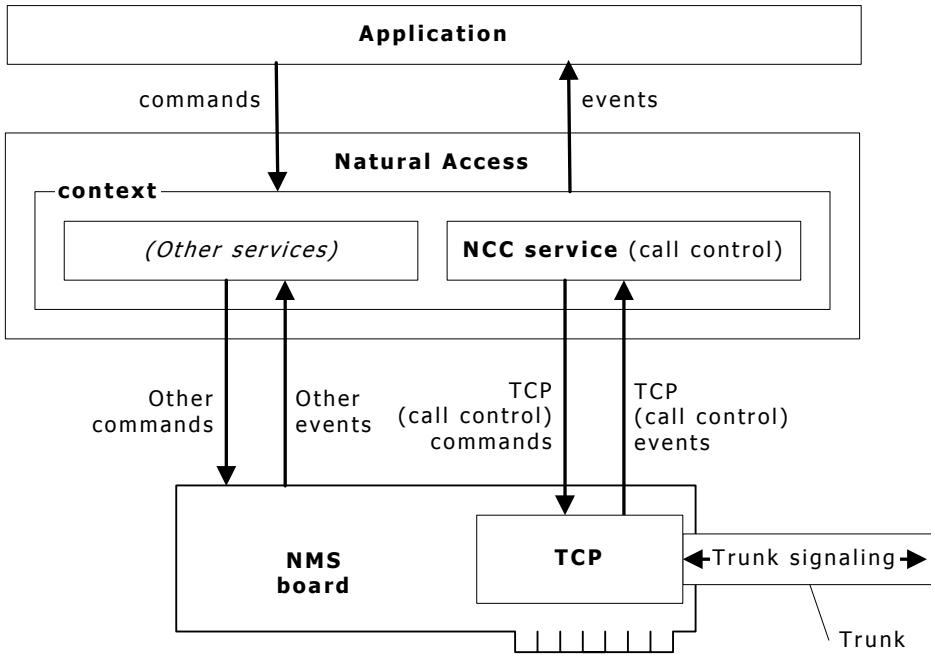
This topic describes:

- Trunk control programs (TCPs)
- Country and network variations
- Protocol software package contents
- Available SLAC files

Trunk control programs (TCPs)

The Natural Call Control (NCC) service provides a call control API that enables an application to establish inbound or outbound calls and to perform call transfer, blocking, and other operations. To keep this API relatively simple and protocol-independent, the communication with the trunk is performed by another software entity called a trunk control program (TCP). The TCP translates commands from the NCC service into channel associated signaling (CAS) appropriate for the particular protocol running on the trunk, and translates protocol-specific trunk events into NCC service events.

The following illustration shows the TCP's role in an application:



NMS CAS software provides a series TCPs for a variety of protocols. The TCP is loaded into the on-board memory of a line interface board when you configure the board. For applications that must support multiple protocols and/or protocol variations simultaneously, more than one TCP can be loaded to the telephony board at the same time. Each line supports one TCP at a time.

For more information, refer to *Configuring NMS boards* on page 15.

Country and network variations

Each country uses its own variation of a protocol. In addition to the basic TCP software, each protocol software package contains several binary parameter files (*.pf* files) that program the protocol for a particular country or network variation. Natural Access applications automatically load these parameters at initialization time.

For more information about loading parameters, refer to *NMS CAS setup tasks* on page 15.

Warning:	You can change only a subset of parameters for each CAS protocol without affecting regulatory approvals. Editing other parameters may result in violations of country-specific regulations. For information about what parameters you can and cannot edit for a specific protocol, refer to the protocol topics in this document.

Protocol software package contents

The software package for a given country-specific protocol includes:

- *readme* file (common for all protocols and countries)
- One or more trunk control programs (TCPs)
- Sample country-specific configuration files
- Four country-specific binary parameter files
- Four editable (ASCII) country-specific parameter files
- One or more SLAC files (for AG 2000 boards)

When you install multiple protocols or install protocols for multiple countries, several versions of each component are created. For more information on the installed components for a protocol, refer to *NMS CAS setup tasks* on page 15.

Natural Access includes several call control demonstration programs that can use any of the NMS CAS protocols to place or receive calls. Refer to the *Natural Call Control Service Developer's Reference Manual* for information about running these programs.

Available SLAC Files

The following SLAC files are available under NCC:

File	Country	Signaling module	Line impedance, ohm	Termination impedance, ohm	Use
a2eurlsc.slc	Australia	Loop start/ CTR21	270 + (750 || 150nF)	270 + (750 || 150nF)	Default
a2usals6.slc	North America	Loop start/US	600+ 2.16uF	600+ 2.16uF	Tests, PBX, default
a2usals9.slc	North America	Loop start/US	900	600+ 2.16uF	PBX
a2usalsn.slc	North America	Loop start/US	(800//0.005uF) + 100	600+ 2.16uF	Unloaded loops
a2eurlsc.slc	Europe	Loop start/ CTR21	270 + (750 || 150nF)	270 + (750 || 150nF)	Default
a2jpnls6.slc	Japan	Loop start/US	600+ 2.16uF	600+ 2.16uF	Tests, PBX, default
a2jpnls9.slc	Japan	Loop start/US	900	600+ 2.16uF	PBX
a2jpnlsn.slc	Japan	Loop start/US	(800//0.005uF) + 100	600+ 2.16uF	Unloaded loops
a2canls6.slc	Canada	Loop start/US	600+ 2.16uF	600+ 2.16uF	Tests, PBX, default
a2canls9.slc	Canada	Loop start/US	900	600+ 2.16uF	PBX
a2canlsn.slc	Canada	Loop start/US	(800//0.005uF) + 100	600+ 2.16uF	Unloaded loops

Note: For the purposes of this table, Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and Switzerland.

3 Setting up NMS CAS

NMS CAS setup tasks

You must set up NMS CAS before an application can use call control functions to place and answer calls. To set up NMS CAS, perform the following tasks:

Task	Description
Configure the boards	Specify the TCPs to be loaded for an application. One or more sample country- and protocol-specific configuration files are installed with each protocol software package. These sample configuration files include statements that make the protocol run appropriately for a particular country.
Configure the trunk control programs (TCPs) for country-specific variations	Add protocols for a particular country, and change default parameters.
Initialize Natural Access	Initialize Natural Access and services (including the NCC service, create contexts and queues, and open services). For information, refer to the *Natural Access Developer's Reference Manual.*
Start the CAS protocols	Use the NCC service to start a TCP.

Configuring NMS boards

Specify configuration information for all boards in the system in an NMS OAM system configuration file and in board keyword files. These files reference managed components that specify whether a board performs CT bus switching, which board is the CT bus clock master, which software modules to transfer to the board's memory on startup (including which TCPs to load), and other settings.

This topic provides the following sample NMS OAM configuration files:

- AG 2000 board: Loop start protocol
- AG 4000 T1 board: WNK protocol
- AG 4000 E1 board: MFC-R2 protocol
- CG 6000C board: MFC-R2 protocol

Run *oamsys* to configure the boards based on the information in the NMS OAM configuration file. *oamsys* transfers all software modules specified in the file to each board, and performs any other configuration activities needed. You should also start *oammon*, which monitors the boards for errors and other events. Use *oamcfg* to change system information or board parameters after the system is running.

oamsys, *oamcfg*, and *oammon* are installed with Natural Access. *oamsys.cfg* is the system configuration file that contains information about the boards in the system and specifies which configuration files to load. For more information, see the *NMS OAM System User's Manual*.

The following table lists the sample NMS OAM board keyword files installed with NMS CAS (where ***prt*** indicates the protocol and ***cty*** indicates the country where used):

File	Location	Description
*a4pi**prt**.cfg*	Windows: *\nms\ag\cfg* UNIX:*/opt/nms/ag/cfg*	For AG 4000/C and AG 4040/C boards. Default example board keyword file to configure one board with all the modules and settings to run protocol ***prt***. It reflects the last country installed in the system for the protocol ***prt***.
*a4pi**prtcty**.cfg*	Windows: *\nms\ag\cfg\country* UNIX: */opt/nms/ag/cfg/country*	For AG 4000/C and AG 4040/C boards. Example board keyword file to configure one board with all the modules and settings to run the protocol ***prt*** in the country ***cty***. A different file is installed for each country.
*a2pi**prt**.cfg*	Windows: *\nms\ag\cfg* UNIX: */opt/nms/ag/cfg*	For AG 2000/C boards. Default example board keyword file to configure one board with all the modules and settings to run protocol ***prt***. It reflects the last country installed in the system for the protocol ***prt***.
*a2pi**prtcty**.cfg*	Windows: *\nms\ag\cfg\country* UNIX: */opt/nms/ag/cfg/country*	For AG 2000/C boards. Example board keyword file to configure one board with all the modules and settings to run the protocol ***prt*** in the country ***cty***. A different file is installed for each country.
*c6**prtcty**.cfg*	Windows: *\nms\cg\cfg\country* UNIX: */opt/nms/cg/cfg/country*	For CG boards. Example CG board keyword file to configure one board with all the modules and settings to run the protocol ***prt*** in the country ***cty***. A different file is installed for each country.

AG 2000 board: Loop start protocol

The following sample NMS OAM board keyword file describes an AG 2000 board using a loop start protocol (LPS) in the USA with 8 ports with 600 ohm network line impedance. The board is configured to run as a stand alone unit. CAS protocol-specific items are **bold**.

Board keyword file sample	Description
`TCPFiles[0] = nocc.tcp` `TCPFiles[1] = lps0.tcp`	Indicates which TCP to load to the board. This setting is protocol-specific. The first statement loads the no call control protocol. The second statement loads the loop start protocol.
`XLaw = mu-LAW`	Defines voice signaling bit patterns sent to the network when the TCP is not active. This is country-specific. mu-law is a companding algorithm used for digital trunks. AG 2000 boards need to know the originating companding law to generate an analog voice signal.

Board keyword file sample	Description

`DLMFiles[0] = gtp.leo`
`DLMFiles[1] = voice.leo`
`DLMFiles[2] = svc.leo`
	Specifies optional runtime components to be transferred to the coprocessor on the board (*leo* files are loadable executable objects).
	The first statement loads the trunk protocol engine. The second one loads the play and record manager. The third one loads the DSP function manager.

`NetworkInterface.Analog[0..7].ConfigFile = a2usals6.slc`	Specifies the AG 2000 board with loop start signaling type and 600 ohm line impedance. Country-specific settings.
`Clocking.HBus.ClockSource = OSC`	Specifies the source from which this board derives its timing. Setting OSC defines the board as a clock master.
`Clocking.HBus.ClockMode = STANDALONE`	Specifies the CT bus clock that the board drives. Set a board in standalone mode so the board references its own clocking information.

`DSP.C5x.DSPFiles[0] = signal`
`DSP.C5x.DSPFiles[1] = tone`
`DSP.C5x.DSPFiles[2] = dtmf`
`DSP.C5x.DSPFiles[3] = mf`
`DSP.C5x.DSPFiles[4] = callp`
`DSP.C5x.DSPFiles[5] = ptf`
`DSP.C5x.DSPFiles[6] = echo.m54`
`DSP.C5x.DSPFiles[7] = oki.m54`
`DSP.C5x.DSPFiles[8] = rvoice.m54`
`DSP.C5x.DSPFiles[9] = voice.m54`
`DSP.C5x.DSPFiles[10] = wave.m54`
	Installs DSP program files. For this configuration, you need at least the statements shown.
	The following DSP functionality is defined by this configuration:
	• Out-of-band channel associated signaling
	• Beep, tone generation, dial
	• DTMF and silence/energy detectors
	• MF detection
	• Call progress detection
	• Pure tone filters
	• Echo cancellation
	• OKI-style play, record
	• RAW voice
	• NMS ADPCM play and record
	• WAVE-style play, record

AG 4000 T1 board: WNK protocol

The following sample NMS OAM board keyword file describes one AG 4000 T1 board set up using a wink start protocol (WNK) for the USA. CAS protocol-specific items are **bold**.

Note: Refer to the *AG 4040 Installation and Developer's Manual* and the *AG 4040C Installation and Developer's Manual* for information about configuring the AG 4040 and AG 4040C boards.

Board keyword file sample	Description
`TCPFiles[0] = wnk0.tcp`	Indicates the TCP to load to the board. The setting here is protocol-specific. The statement loads the wink start protocol.
`Xlaw = MU-LAW`	Defines the switch idle codes.

`DLMFiles[0] = gtp.leo`
`DLMFiles[1] = voice.leo`
`DLMFiles[2] = svc.leo`
	Specifies optional runtime components to be transferred to the coprocessor on the board (*leo* files are loadable executable objects).
	The first statement loads the trunk protocol engine. The second one loads the voice manager. The third one loads the DSP function manager.

`Clocking.HBus.ClockSource = NETWORK`	Specifies the source from which this board derives its timing. Specifies a digital trunk as the board's clock source. **Note:** If you select NETWORK, you must complete Clocking.HBus.ClockSourceNetwork.
`Clocking.HBus.ClockSourceNetwork = 1`	Specifies the number of a trunk that the board uses as an external network clocking source for its internal clock.
`Clocking.HBus.ClockMode = STANDALONE`	Specifies the CT bus clock that the board drives. Sets a board in standalone mode so the board references its own clocking information.
`NetworkInterface.T1E1[0..3].FrameType = D4` `NetworkInterface.T1E1[0..3].LineCode = AMI_ZCS`	Sets up trunk information for the board to match the connected equipment.

Board keyword file sample	Description

`DSP.C5x.DSPFiles[0] = tone`
`DSP.C5x.DSPFiles[1] = callp`
`DSP.C5x.DSPFiles[2] = dtmf`
`DSP.C5x.DSPFiles[3] = voice`
`DSP.C5x.DSPFiles[4] = mf`
`DSP.C5x.DSPFiles[5] = ptf`
`# Uncomment and put in the correct counter:`
`# DSP.C5x.DSPFiles[X] = rvoice`
`# DSP.C5x.DSPFiles[X] = okiply`
`# DSP.C5x.DSPFiles[X] = okirec`
`# DSP.C5x.DSPFiles[X] = wavply`
`# DSP.C5x.DSPFiles[X] = wavrec`
	Installs DSP program files. For this configuration, you need at least the statements shown. The following DSP functionality is defined by this configuration:
	• Beep, tone generation, dial
	• Call progress detection
	• DTMF and silence/energy detectors
	• NMS ADPCM play and record
	• MF detection, compelled sequences
	• RAW voice
	• OKI-style play
	• OKI-style record
	• WAVE-style play
	• WAVE-style record

AG 4000 E1 board: MFC-R2 protocol

The following sample NMS OAM board keyword file describes one AG 4000 E1 board set up using a MFC-R2 protocol. CAS protocol-specific items are **bold**.

Note: Refer to the *AG 4040 Installation and Developer's Manual* and the *AG 4040C Installation and Developer's Manual* for information about configuring the AG 4040 and AG 4040C boards.

Board keyword file sample	Description
TCPFiles[0] = mfc0.tcp	Indicates the TCP to load to the board. The setting here is protocol-specific. The statement loads the MFC-R2 TCP.
VoiceIdleCode = 0xd5 **SignalIdleCode = 0x9**	Defines voice signaling bit pattern sent to the network when the TCP is not active. This is country-specific. Specifies the A-Law silence, idle bit pattern.
LoadFile = ag4000.lod **RunFile = ag4000.cor**	Specifies runtime components to be loaded to the board. This is board and protocol specific. **Note:** If you are using an AG 4040/C board, specify *ag4040.lod* and *ag4040.cor* for these files.
DLMFiles[0] = gtp.leo DLMFiles[1] = voice.leo DLMFiles[2] = svc.leo	Specifies optional runtime components to be transferred to the coprocessor on the board (*leo* files are loadable executable objects). The first statement loads the trunk protocol engine. The second one loads the voice manager. The third one loads the DSP function manager.
Clocking.HBus.ClockSource = NETWORK	Specifies the source from which this board derives its timing. Specifies a digital trunk as the board's clock source. **Note:** If you select NETWORK, you must complete Clocking.HBus.ClockSourceNetwork.
Clocking.HBus.ClockSourceNetwork = 1	Specifies the number of a trunk that the board uses as an external network clocking source for its internal clock.
Clocking.HBus.ClockMode = STANDALONE	Specifies the CT bus clock that the board drives. Sets a board in standalone mode so the board references its own clocking information or a digital network source.
NetworkInterface.T1E1[0..3].FrameType = CEPT NetworkInterface.T1E1[0..3].LineCode = HDB3	Sets up trunk information for the board to match the connected equipment.

CG 6000C board: MFC-R2 protocol

The following sample board keyword file describes a CG 6000C board using an MFC-R2 protocol. For more information about board-specific entries, refer to the *CG 6000C Installation and Developer's Manual*. CAS protocol-specific items are **bold**.

Board keyword file sample	Description
`Clocking.HBus.ClockSource = OSC` `Clocking.HBus.ClockSourceNetwork = 1`	Specifies the source from which this board derives its timing. Settings OSC define the board as a clock master.
`Clocking.HBus.ClockMode = STANDALONE`	Specifies the CT bus clock that the board drives. Sets a board in standalone mode so the board references its own clocking information.
`TCPFiles = mfc0.tcp`	Indicates the TCP to load to the board. The setting here is protocol-specific. The statement loads the MFC-R2 TCP.
`DSPStream.VoiceIdleCode[0..3] = 0xd5` **`DSPStream.SignalIdleCode[0..3] = 0x9`**	Defines the voice signaling bit pattern sent to the network when the TCP is not active. This is country-specific. Specifies the A-Law silence, idle code pattern.
`NetworkInterface.T1E1[0..3].Type = E1`	Specifies the trunk type for each trunk on the board.
`NetworkInterface.T1E1[0..3].Impedance = G703_120_OHM`	Specifies the type of cable connecting to the telephone network.
`NetworkInterface.T1E1[0..3].SignalingType = CAS`	Determines how voice and signaling information is routed to and from the E1 or T1 trunk and DSP resources.
`NetworkInterface.T1E1[0..3].FrameType = CEPT`	Defines the framing format for the current board or trunk.
`NetworkInterface.T1E1[0..3].LineCode = HDB3`	Specifies the ones density maintenance method used on the trunk line to maintain a clear channel transmission.
`DLMFiles[0] = cg6krun`	Specifies an optional runtime component (modular extension to the core file) to be transferred to the board by the configuration file.
`DSP.C5x[0..31].Libs[0] = cg6kliba`	Specifies the DSP library file name.
`DSP.C5x[0..31].XLaw = A_LAW`	Determines the DSP hardware companding mode. **Note:** All DSPs must have the same value.

`DSP.C5x[0].Files = qtsignal callp tone \`
`dtmf ptf mf echo`
`DSP.C5x[1..31].Files = voice tone dtmf \`
`echo rvoice callp ptf wave oki ima gsm_ms`
`g726 mf`
	Specifies digital signal processor function modules (DPFs) loaded to board DSPs for applications to use on a per-call/channel basis.

Board keyword file sample	Description
`Resource[0].Definitions = ( dtmf.det_all & \` `echo.ln20_apt25 & ptf.det_2f & \` `tone.gen & \callp.gnc & ptf.det_4f & \` `((rvoice.rec_mulaw & rvoice.play_mulaw)	\` `(rvoice.rec_alaw & rvoice.play_alaw)	\` `(rvoice.rec_lin & rvoice.play_lin)	\` `(voice.rec_16 & (voice.play_16_100 | \` `voice.play_16_150 | voice.play_16_200))	\` `(voice.rec_24 & (voice.play_24_100 | \` `voice.play_24_150 | voice.play_24_200))	\` `(voice.rec_32 & (voice.play_32_100 | \` `voice.play_32_150 | voice.play_32_200))	\` `(voice.rec_64 & (voice.play_64_100 | \` `voice.play_64_150 | voice.play_64_200))	\` `(wave.rec_11_16b & wave.play_11_16b)	\` `(wave.rec_11_8b & wave.play_11_8b)	\` `(oki.rec_24 & (oki.play_24_100 | \` `oki.play_24_150 | oki.play_24_200))	\` `(oki.rec_32 & (oki.play_32_100 | \` `oki.play_32_150 | oki.play_32_200))	\` `(ima.rec_24 & ima.play_24)	\` `(ima.rec_32 & ima.play_32)	\` `(gsm_ms.frgsm_rec & gsm_ms.frgsm_play)	\` `g726.rec_32	g726.play_32))`	Provides a relational string of DPFs that describes the functionality that can occur on a single port, and describes how the functions execute in relation to each other. The DPFs in this string specify the functions that execute on the DSPs and whether they execute simultaneously. Resource[***x***].Definitions specifies the processing functions that are available to applications during the life of a call or channel. For example, if you expect to run echo cancellation at any time on the board, an echo DPF must be specified in this keyword. Since echo runs at the same time as the decoder and encoder in the universal ports full duplex implementation, the Resource string must combine echo (using the AND operator) with the decoder and the encoder.
`DebugMask = 0x0`	Specifies the type and level of tracing that the board performs.

Configuring TCPs

Many protocol features can differ from country to country, or even within the same country.

Configure NMS CAS TCP parameters to specify the appropriate behavior for different countries and networks. When you install NMS CAS for NCC, you specify the country and protocols to use. NMS CAS runs protocols for only one country at a time (the last country loaded). You can load multiple protocols for a single country. You can also override the defaults for particular parameters by editing the corresponding ASCII *.par* file for that country.

This topic describes:

- Verifying TCP file locations
- Adding protocols for a particular country
- Changing default parameters
- Changing a specified country
- Adding and changing parameter files automatically

Many of the protocols included in this manual can do more than is described here. For more information, contact NMS Communications.

Verifying TCP file locations

Before configuring a TCP, make sure that the appropriate CAS parameter files are in the proper locations.

A binary parameter file for the target country must be in the directory specified by the AGLOAD environment variable. These binary files contain compiled-in default values for all of the country-specific parameters. Natural Access loads these parameters when it is initialized.

Parameter file	Description
nccxadi.pf	Defines the Natural Access parameter category NNC.X.ADI_START and NCC.X.ADI_PLACECALL. These parameter categories include all of the country-specific parameters for AG and CG boards.
nccstart.pf	Defines the Natural Access parameter category NCC.START. NCC.START parameters include country-specific parameters for the last country installed.
*nccx**prt**.pf* where ***prt*** indicates the protocol.	Defines the Natural Access parameter category NCC.X.ADI_***prt***. This category holds all protocol-specific parameters for the specified protocol. The parameter default values defined by this file apply to the TCP implementing the protocol for the last country installed.

A single country-specific instance of the binary parameter file is in the AGLOAD path for each protocol. Otherwise, the NCC service will not start.

The Natural Access installation program installs backup copies of the binary parameter files. The following table lists the names and locations of these backup files. Where ***prt*** indicates the protocol and ***cty*** indicates the country where used:

Binary parameter file	Backup file	Windows backup file location	UNIX backup file location
*nccx**prt**.pf*	*nccx**prtcty**.pf*	*\nms\ag\cfg\country*	*/opt/nms/ag/cfg/country*
nccxadi.pf	*nccxadi**cty**.pf*	*\nms\ag\cfg\country*	*/opt/nms/ag/cfg/country*
nccstart.pf	*nccstart**cty**.pf*	*\nms\ag\cfg\country*	*/opt/nms/ag/cfg/country*

Adding protocols for a particular country

To manually add protocols for a particular country, copy the binary parameter files for that country/protocol from the backup directory to the binary parameter file directory:

Copy this file...	From this directory...	To this directory...	And rename the file to...
*nccx**prtcty**.pf*	Windows: *\nms\ag\cfg\country* or UNIX: */opt/nms/ag/cfg/country*	Windows: *\nms\ag\cfg* or UNIX: */opt/nms/ag/cfg*	*nccx**prt**.pf*

prt indicates the protocol and ***cty*** indicates the country where used.

Changing default parameters

To reset the values of the country-specific parameters, use the ASCII parameter value definition files. These files can be used to set the parameter values system-wide, using *ctdaemon*, or the application can parse the values for dynamic parameter management with Natural Access functions.

Parameters within the ASCI parameter files fall within the following classes:

- Those that you can change to fit the application's needs
- Those that should not be changed because they have regulatory relevance.

The following table lists the ASCII parameter value definition files:

File	Location	Description
*nccx**prt**.par*	Windows: *\nms\ctaccess\cfg* UNIX: */opt/nms/ctaccess/cfg*	Defines the Natural Access parameter category NCC.X.ADI_***prt***. This category holds all protocol-specific parameters for the ***prt*** protocol. The parameter default values defined by these files apply to the TCP implementing the protocol ***prt*** for the last country installed.
nccxadi.par	Windows: *\nms\ctaccess\cfg* UNIX: */opt/nms/ctaccess/cfg*	Defines the Natural Access parameter category NNC.X.ADI_START and NCC.X.ADI_PLACECALL. These parameter categories include all of the country-specific parameters for AG and CG boards.
nccstart.par	Windows: *\nms\ctaccess\cfg* UNIX: */opt/nms/ctaccess/cfg*	Defines the Natural Access parameter category NCC.START. NCC.START parameters include all of the country-specific parameters for the last country installed.

Manually changing default TCP parameters

Complete the following steps to manually change default TCP parameters:

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Make changes to the values in ASCII parameter files (*.par file) and save the changes.</td></tr>
<tr><td>2</td><td>Copy ASCII parameter files to the appropriate directory and rename:
<table>
<tr><th>Copy this file...</th><th>From this directory...</th><th>To this directory...</th><th>And rename the file to...</th></tr>
<tr><td>nccxprtcty.par
nccxadicty.par
nccstartcty.par</td><td>Windows:
\nms\ctaccess\cfg\country
or
UNIX:
/opt/nms/ctaccess/cfg/country</td><td>Windows:
\nms\ctaccess\cfg
or
UNIX:
/opt/nms/ctaccess/cfg</td><td>nccxprt.par
nccxadi.par
nccstart.par</td></tr>
</table>
prt indicates the protocol and cty indicates the country where used.</td></tr>
<tr><td>3</td><td>Load the changed parameters in one of the following ways:
Use ctdaemon to set system-wide parameters by entering:
<code>ctdaemon -f filename</code>
where filename can be one of the previously listed files or an edited file containing all of the changed parameters. You can add all the changed parameters to the ctapar section of cta.cfg.
Any Natural Access application started subsequently on the system will share the parameter values contained in the *prt.par file, as long as ctdaemon is kept running. Refer to the Natural Access Developer's Reference Manual for more information.</td></tr>
<tr><td>4</td><td>In your application, call ctaLoadParameterFile and provide the appropriate parameter file as the function's argument.
Call ctaSetParmByName for each parameter specified in the file. This sets new default values. Use this procedure for systems running in command line mode in Windows and other operating systems. When running as a Windows service, copy the modified parameters to cta.cfg. Then restart the service.
Note: You must modify parameters before starting the specified TCP for the new parameter values to take effect.</td></tr>
</table>

Warning:	You can change only a subset of parameters for each CAS protocol without affecting regulatory approvals. For information about what parameters you can and cannot edit for a specific protocol, refer to the protocol topics in this document. Editing other parameters may result in violations of country-specific regulations.

Changing a specified country

To change the specified country for NMS CAS protocols, copy the country specific binary parameters files for that country and protocols from the backup directory to the binary parameter file directory:

Copy this file...	From this directory...	To this directory...	And rename the file to...
*nccx**prtcty**.pf* *nccxadi**cty**.pf* *nccstart**cty**.pf*	Windows: *\nms\ag\cfg\country* or UNIX: */opt/nms/ag/cfg/country*	Windows:*\nms\ag\cfg* or UNIX: */opt/nms/ag/cfg*	*nccx**prt**.pf* *nccxadi.pf* *nccstart.pf*

prt indicates the protocol and ***cty*** indicates the country where used.

Note: You can use NMS CAS protocols for only one country at a time. The country used is the last country whose protocols were loaded.

Adding and changing parameter files automatically

NMS CAS for Natural Call Control software includes a *switchpar* utility for adding and changing binary and ASCII parameter files for particular protocols. *switchpar* automatically copies and renames the appropriate parameter files to the correct directories and file names.

To use *switchpar*, run the following command from the command line:

Operating system	Command
Windows	`switchpar cty prt nmsroot`
UNIX	`switchpar.sh cty prt`

Where:

- ***cty*** indicates the three letter country abbreviation
- ***prt*** indicates the three letter protocol abbreviation
- ***nmsroot*** indicates the root directory for NMS software on the system (the default is *\nms*).

Note: Running *switchpar* for a protocol that has already been installed automatically overwrites any changes you may have made to that protocol's editable parameters.

If *ctdaemon* is running when you change parameters, stop and restart the program to initialize the parameters.

Starting CAS protocols

Before starting a CAS protocol, the application must initialize Natural Access and obtain context handles. The TCP parameters are automatically loaded during initialization. For information about initializing Natural Access and obtaining context handles, refer to the *Natural Access Developer's Reference Manual*.

This topic provides the following information:

- Using **nccStartProtocol**
- Using CAS protocols

Using nccStartProtocol

When a context is open and the TCP parameters are loaded, the application can start a protocol on that context according to the loaded parameters (see *Configuring TCPs* on page 23). Invoke **nccStartProtocol** to start a TCP. After a TCP is started on a context, the application can use call control functions to place and answer calls on that context.

Note: To start a TCP from within an application, the TCP must have been downloaded to the board during system initialization. The configuration utility downloads all TCPs specified in the board keyword file. For more information about the board keyword file, see *Configuring NMS boards* on page 15.

nccStartProtocol requires a TCP name as one of its arguments. CAS TCPs include the following:

Protocol	TCP name
Analog loop start	lps0
Australian P2	ap20
EL7	el70
European digital CAS	euc0
Feature group D	fgd0
Digital ground start	gds0
MELCAS	mel0
MF-Socotel	mfs0
Multi-frequency compelled R2	mfc0
NEC PBX	nec0
Off-premises station	ops0
Operator workstation	sta0
Pulsed E and M	eam0
Signaling system 5	ss50
System R1.5 (inbound calls)	r150
System R1.5 (outbound calls)	r151
Wink start (digital and analog)	wnk***x*** (***x***=0,1)

After the application calls **nccStartProtocol**, it receives NCCEVN_STARTPROTOCOL_DONE. If the TCP is started successfully, the event value field contains CTA_REASON_FINISHED. Otherwise, the value field contains a reason code that describes the error that occurred.

If your application terminates, all channels associated with the application are terminated, the TCP shuts down, and the bit pattern specified in the IdleCode statement in the board keyword file is signaled on the line.

Using CAS protocols

On AG boards, DSP functions started by the TCP (for example, DTMF detection) cannot be active while calls are in the connected state. For this reason, when calling **nccStartProtocol,** the value of the NCC service parameter mediamask (in the NCC.X.ADI_START_PARMS structure) must be set to 0.

If mediamask is not set to 0, the TCP does not start and the application receives the NCCEVN_STARTPROTOCOL_DONE event with the reason NCC_REASON_OUT_OF_RESOURCES. The application must then set mediamask to zero before starting the protocol again.

For information about NCC.X.ADI_START parameters, refer to *NCC call control parameters* on page 47.

For information about managing DSP resources on CG boards, refer to the appropriate board installation manual.

4 Using NCC service call control

NCC functions and solicited events

The following table lists NCC service functions and solicited events. Solicited events signify acknowledgments from the TCP of particular function calls. Functions are listed in alphabetical order. For detailed documentation of the functions, parameters, and events, refer to the *Natural Call Control Service Developer's Reference Manual*.

Function	Description and associated events
nccAcceptCall	Accepts an incoming call without answering or rejecting it. This allows the application to perform media functions (such as playing a voice file) before connecting (or rejecting) an inbound call. **Note:** Not all protocols support this function and the accepting state. The application can determine if the protocol supports this state by examining the NCC_CAP_ACCEPT_CALL bit in the capabilitymask returned by **nccQueryCapability**. If the remote party disconnects while the application accepts the call, then the application receives NCCEVN_CALL_DISCONNECTED. In this case, no NCCEVN_ACCEPTING_CALL event is delivered to the application. The application can accept a call using the following modes: • NCC_ACCEPT_PLAY_SILENT: Do not play anything (digital trunks only). • NCC_ACCEPT_PLAY_RING: Play a ring tone (works on all trunks). • NCC_ACCEPT_USER_AUDIO: The application may generate a recorded message. If the remote party disconnects, the TCP interrupts the message (digital trunks only). **Note:** NCC_ACCEPT_PLAY_RING and NCC_ACCEPT_USER_AUDIO are not supported by all protocols. The application can determine if the protocol supports this capability by examining the NCC_CAP_MEDIA_IN_SETUP bit in the capabilitymask returned by **nccQueryCapability**. NCC_ACCEPT_PLAY_SILENT is the default accept mode supported by all protocols. **Associated events:** • NCCEVN_ACCEPTING_CALL: The function has completed successfully and the call has entered the accepting call state. • NCCEVN_CALL_DISCONNECTED: The remote party has disconnected. The call enters the disconnected call state.

Function	Description and associated events
nccAnswerCall	Answers an incoming call. If **nccAnswerCall** completes successfully, the call enters the answering call state. The application receives NCCEVN_ANSWERING_CALL. When the call is connected, the application receives NCCEVN_CALL_CONNECTED, and the call enters the connected call state. If the remote party disconnects while the call is in the answering call state, the application receives NCCEVN_CALL_DISCONNECTED. **Associated events:** • NCCEVN_ANSWERING_CALL: The function has completed successfully and the call has entered the answering call state. • NCCEVN_CALL_CONNECTED: The call is connected. The call enters the connected call state. • NCCEVN_CALL_DISCONNECTED: The remote party has disconnected. The call enters the disconnected call state.
nccAutomaticTransfer	Transfers a call on a PBX, Centrex, or Centrex-like line. **nccAutomaticTransfer** executes a blind transfer by performing placement of a second call and completing call transfer. **nccAutomaticTransfer** operates only when the first call handle is in the connected state or is on hold. **Note:** Not all protocols support automatic call transfer. The application can determine if the protocol supports this state by examining the NCC_CAP_AUTOMATIC_TRANSFER bit in the capabilitymask returned by **nccQueryCapability**. The application determines when the call is to be transferred by specifying: • NCC_TRANSFER_PROCEEDING: After the transfer address is dialed. • NCC_TRANSFER_ALERTING: When a ring is detected. • NCC_TRANSFER_CONNECTED: When called party answers. **Associated events:** • NCCEVN_CALL_HELD: Indicates that the second call (to the transfer address) is in placing call state. • NCCEVN_CALL_RETRIEVED: Indicates that the transfer failed. The event value field contains a NCC_DIS_xxx reason code indicating why the transfer failed. • NCCEVN_CALL_DISCONNECTED: First call is in disconnected call state. Receipt of this event with reason code NCC_DIS_TRANSFER indicates successful completion of the automatic transfer. The application should release this call handle with **nccReleaseCall**. **Note:** Other protocol-specific errors or reasons for disconnecting may be reported.

Function	Description and associated events
nccBlockCalls	Blocks calls on a specified line handle. **nccBlockCalls** may be invoked from any line state, however, incoming calls will not be blocked until there are no calls on the line (the line has returned to idle line state). When using **nccBlockCalls**, specify the method to be used to block calls. Two methods are valid: • NCC_BLOCK_REJECTALL: Do not answer subsequent calls. • NCC_OUT_OF_SERVICE: Place the line out of service. When the line state has changed to blocking, the application receives NCCEVN_CALLS_BLOCKED. The value returned with this event contains the chosen blocking method. The line remains in the blocking state until **nccUnblockCalls** is called. The application may receive NCCEVN_INCOMING_CALL after invoking **nccBlockCalls** and before receiving NCCEVN_CALLS_BLOCKED. The application must handle the incoming call (accept it, answer it, etc.). The application will not receive the NCCEVN_CALLS_BLOCKED event until it releases all calls. If the blocking request fails for some reason, the application receives NCCEVN_BLOCK_FAILED. The line remains in the current state. **nccUnBlockCalls** can be used to cancel a blocking request initiated using **nccBlockCalls**. A blocking request can be canceled any time before NCCEVN_CALLS_BLOCKED is received. **Associated events**: • NCCEVN_CALLS_BLOCKED: The block calls request completed successfully. The line state has changed to blocking. • NCCEVN_BLOCK_FAILED: The request to block calls failed. The event value field contains the reason.
nccDisconnectCall	Disconnects a call that is connected to the network. **nccDisconnectCall** may also be used to abandon outbound call placement. The NCC_CAP_DISCONNECT_IN_ANY_STATE bit in the capabilitymask returned by **nccQueryCapability** determines the states in which **nccDisconnectCall** can be invoked. If the bit is set, **nccDisconnectCall** may be invoked in any call state except disconnected. If the bit is cleared, **nccDisconnectCall** can only be invoked in the connected call state. A disconnected call is no longer active. If no active calls exist on a line, the line state changes to idle. **Associated event:** NCCEVN_CALL_DISCONNECTED indicates that the disconnect operation has completed successfully and the call has entered the disconnected call state.
nccGetCallStatus	Retrieves the call control status and stores it in an NCC_CALL_STATUS structure. Caller ID data is written to the NCC_CALL_STATUS structure. Applications that require caller ID data can check the calling party's ID by invoking **nccGetCallStatus** once NCCEVN_INCOMING_CALL is received, or by waiting for NCCEVN_CALL_STATUS_UPDATE, with a value code of NCC_CALL_STATUS_CALLINGADDR. For more information, refer to the *NCC_CALL_STATUS structure* on page 40. **Associated events:** None.
nccGetExtendedCallStatus	Retrieves protocol-specific status information for a call and stores it in an NCC_CAS_EXT_CALL_STATUS structure. For more information, refer to the *NCC_CAS_EXT_CALL_STATUS structure* on page 42. **Associated events:** None.

Function	Description and associated events
nccGetLineStatus	Retrieves a snapshot of the port status and stores it in an NCC_LINE_STATUS structure. **Associated events:** None.
nccHoldCall	Puts a connected call on hold. There is no call state transition, but a call on hold is no longer active. Since there are no active calls currently on the line, the line state changes to idle. The call is on hold only after the application receives an NCCEVN_CALL_HELD event. The held field in the NCC_CALL_STATUS structure is set to a non-zero value. Use **nccRetrieveCall** to take the call off hold. Some protocols do not support the capability to put a call on hold. The application can determine if the protocol supports call hold/retrieve by examining the NCC_CAP_HOLD_CALL bit in the capabilitymask returned by **nccQueryCapability**. Some protocols allow a call to be put on hold only from the connected state. The application can determine whether or not a call can be put on hold from any state by examining the NCC_CAP_HOLD_IN_ANY_STATE bit in the capabilitymask returned by **nccQueryCapability**. **Associated events:** • NCCEVN_CALL_HELD: The call hold attempt completed successfully and the call is now on hold. The line state is now idle. • NCCEVN_HOLD_REJECTED: The request to put a call on hold was rejected. The value field contains information as to why the request was rejected.

Function	Description and associated events
nccPlaceCall	Places an outbound call to a specified digit string according to call placement parameters specified in NCC_ADI_PLACECALL_PARMS. NCCEVN_PLACING_CALL indicates that the call placement operation has completed successfully and the call has entered the placing call state. If the application receives NCCEVN_CALL_RELEASED (with an NCC_RELEASED_FALSE_SEIZURE reason code) instead of NCCEVN_PLACING_CALL, the line was seized for an incoming call before glare was resolved, and the TCP has released the outgoing call. The application should immediately abandon outbound call placement and handle the incoming call. The address digits can be sent all at once when invoking the function, or (with some protocols) digits can be sent in an overlapped fashion. **Associated events:** • NCCEVN_PLACING_CALL: The TCP has seized an outbound trunk and resolved glare, and the call has entered the placing call state. • NCCEVN_CALL_RELEASED: An incoming call was detected while call placement was taking place. The TCP has released the outbound call. The event value field contains NCC_RELEASED_GLARE. • NCCEVN_CALL_PROCEEDING: The switch has accepted the call setup. The receiving side is being rung. The call enters the proceeding call state. • NCCEVN_REMOTE_ALERTING: The remote end is in an alerting state (for example, is ringing). This event is generated only if the NCC_REPORT_ALERTING bit is set in the NCC.START.eventmask parameter. • NCCEVN_REMOTE_ANSWERED: Generated at the first positive indication that the remote party has answered (for example, out-of-band signaling, voice, or modem tone). The event value field contains the indication type. This event is generated only if the NCC_REPORT_ANSWERED bit is set in the NCC.START.eventmask parameter. • NCCEVN_CALL_CONNECTED: Both parties are now connected. The call enters the connected call state.
nccQueryCapability	Queries the capabilities of the protocol on a given line handle. The application can invoke this function to determine if the current protocol supports a given feature. **nccQueryCapability** returns an NCC_PROT_CAP structure containing capability information for the protocol. **Associated events:** None.

Function	Description and associated events
nccRejectCall	Rejects an incoming call. **nccRejectCall** causes the protocol to reject the incoming call using the method specified by method. Valid methods are: • NCC_REJECT_PLAY_RINGTONE: Play ring tone (only option on analog trunks). • NCC_REJECT_PLAY_BUSY: Plays a busy tone (digital trunks only). • NCC_REJECT_PLAY_REORDER: Plays a reorder tone (digital trunks only). • NCC_REJECT_USER_AUDIO: The application generates a recorded message, or a special information tone. If the remote party hangs up, the TCP interrupts the application tone or voice file (digital trunks only). When a call is being rejected, the application receives NCCEVN_REJECTING_CALL. To use the default rejection behavior for the current protocol, set method to 0. **Note:** If the remote party disconnects while the application is rejecting the call, the application receives NCCEVN_CALL_DISCONNECTED only. In this case, NCCEVN_REJECTING_CALL is not delivered. **Associated events:** • NCCEVN_REJECTING_CALL: The reject call operation has completed successfully and the call has entered the rejecting call state. • NCCEVN_CALL_DISCONNECTED: The remote party disconnected.
nccReleaseCall	Releases resources associated with a call in the disconnected state, and destroys a call handle. **nccReleaseCall** can only be called when a call is in the disconnected state. When a call is released, it is completely destroyed. The application can no longer retrieve call status information. **Associated event:** NCCEVN_CALL_RELEASED is returned after the protocol has performed the network procedures for releasing the call. All internal resources allocated to the call are released. After the application receives this event, no more DSP-related events are generated for this call handle.
nccRetrieveCall	Retrieves a call previously placed on hold with **nccHoldCall**. The call becomes active again. The line state changes to active. **Associated events:** • NCCEVN_CALL_RETRIEVED: The call retrieve attempt completed successfully and the call is now no longer on hold. • NCCEVN_RETRIEVE_REJECTED: The request to retrieve the call was rejected.
nccSendCallMessage	Pass through mechanism to send a protocol-specific call message directly to the TCP. Not used for CAS protocols. **Associated events:** None.
nccSendDigits	Continues the process of sending digits to place an outbound call (for protocols that support overlapped sending of digits). **Associated events:** None.
nccSendLineMessage	Pass through mechanism to send a protocol-specific line message. Not used for CAS protocols. **Associated events**: None.

Function	Description and associated events
nccStartProtocol	Prepares an uninitialized line to be used by a protocol to accept and/or place calls. When invoked, **nccStartProtocol** returns NCCEVN_START_PROTOCOL_DONE. This event acknowledges the protocol startup attempt. The event value field indicates whether the attempt was successful or not. **Associated event:** NCCEVN_START_PROTOCOL_DONE: Acknowledges the attempt by the application to start a protocol on a context (line handle). The event value field indicates if the protocol was started or not. The following reason codes may be returned: • CTA_REASON_FINISHED indicates that the protocol has successfully been started on a context (line handle). The line state changes from uninitialized to idle. • NCCREASON_OUT_OF_RESOURCES indicates that the protocol has not been started, because the mediamask parameter is not set correctly. The line remains in uninitialized line state. See the hardware documentation for details.
nccStopProtocol	Uninitializes an NCC line. If this command succeeds, the line state becomes uninitialized. Any calls that are on the line are released. An NCCEVN_CALL_RELEASED event is generated for each released call. Then an NCCEVN_STOP_PROTOCOL_DONE event is returned. **Associated events:** • NCCEVN_START_PROTOCOL_DONE: The line state has successfully changed from idle to uninitialized. It can no longer be used to accept and/or place calls. • NCCEVN_CALL_RELEASED: A call that was on the line was released before the protocol was stopped.
nccTransferCall	Completes supervised transfer of two calls. Only one of the two call handles can be in the connected state and not be on hold. Both calls must be on the same line (context) handle. When the transfer is completed, the application should invoke **nccReleaseCall** for both call handles to release their resources. **Note:** Not all protocols support supervised call transfer. The application can determine if the protocol supports this state by examining the NCC_CAP_SUPERVISED_TRANSFER bit in the capabilitymask returned by **nccQueryCapability**. When the transfer is completed, call **nccReleaseCall** to go back to the idle state. **Associated event:** NCCEVN_CALL_DISCONNECTED should be returned twice, once for each call. The event indicates that the call is disconnected (from the point of view of the application). If the call transfer is successful, the NCC_DIS_TRANSFER reason code is returned with this event. Other protocol-specific reason codes may be reported for failure to complete transfer. The CTA_EVENT structure containing this event also contains the first call handle (***callhd1***) of the **nccTransferCall** invocation.

Function	Description and associated events
nccUnBlockCalls	Used to release blocking of calls on the specified line (context) handle. When the line state has changed from blocking to idle, the application receives NCCEVN_CALLS_UNBLOCKED. It can then receive or place new calls. **nccUnblockCalls** may be used to cancel a previous **nccBlockCalls** invocation before the protocol is able to start blocking calls on the specified line. In this case, the application receives no events. If the call unblocking request fails for some reason, the application receives NCCEVN_UNBLOCK_FAILED. The line remains in the blocking line state. **Associated events:** • NCCEVN_CALLS_UNBLOCKED: The unblock calls request completed successfully. The line state has changed to Idle. • NCCEVN_UNBLOCK_FAILED: The request to unblock calls failed. The event value field contains the reason.

The NCC.START.eventmask parameter dictates whether certain informational call control events are generated. For detailed information about this structure, refer to the *Natural Call Control Service Developer's Reference Manual*.

NCC unsolicited events

Unsolicited events can occur at any time, regardless of the application's current activities. The following table lists the NCC unsolicited events:

Event	Description
NCCEVN_BILLING_INDICATION	Indicates that a billing indication was detected for an outbound call. This can be a billing pulse or some more complex indication. The event value field may contain the billing units charged, depending upon the protocol implementation. This event is generated only if the NCC_REPORT_BILLING bit is set in the NCC.START.eventmask parameter.
NCCEVN_CALL_CONNECTED	Indicates that a call has reached the connected call state. The event value field contains the reason for connection.
NCCEVN_CALL_DISCONNECTED	This event indicates one of the following: • The application invoked **nccDisconnectCall**. • The remote party hung up. This event can occur in almost any call state. • The call is inbound, and the application rejected the call. • The call is outbound, the remote party answered, and the call failed to meet the criteria specified by the NCC_ADI_PLACECALL_PARMS connectmask passed with **nccPlaceCall**, or met the criteria specified by the disconnectmask. The event value field contains the reason that the call was disconnected. A disconnected call is no longer considered active. If there are no active calls on a line (all calls on the line are either held or disconnected), the line state returns to idle. Disconnected calls should be released using **nccReleaseCall**.

Event	Description
NCCEVN_CALL_HELD	Indicates that a call has been placed on hold, either by the application or by a remote party. When a call is placed on hold, no call state change occurs. However, a call on hold is not considered active. If there are no active calls on a line (any calls on the line are either held or disconnected) the line state returns to idle. Call holding is not supported by all protocols. The NCC_CAP_HOLD_CALL indicator in the capabilitymask returned by **nccQueryCapability** indicates if the current protocol supports this event or not. Ordinarily, a call can only be placed on hold in the connected call state. However, if the NCC_CAP_HOLD_IN_ANY_STATE indicator is set in the capabilitymask for the protocol, the application can place a call on hold regardless of the call state. The application can call **nccGetCallStatus** to determine whether a call is on hold or not. If a call is on hold, the held attribute in the NCC_CALL_STATUS structure returned for that call contains a non-zero value.
NCCEVN_CALL_PROCEEDING	Indicates that the switch has accepted the call setup request, and is in the process of attempting to ring the receiving end. Call progress analysis is begun. The call state changes to proceeding.
NCCEVN_CALL_RETRIEVED	Indicates that a call on hold was retrieved, either by the application or by a remote party. The call is now active. Since there is an active call on the line, the line state changes to active. Call hold/retrieve is not supported by all protocols. NCC_CAP_HOLD_CALL in the capabilitymask returned by **nccQueryCapability** indicates if the current protocol supports this capability. The application can call **nccGetCallStatus** to determine whether a call is on hold. If a call is on hold, the held attribute in the NCC_CALL_STATUS structure returned for that call contains a non-zero value. If an automatic transfer fails, NCCEVN_CALL_RETRIEVED is returned, with a value field containing one of the NCC_DIS_xxx reason codes indicating why the transfer failed.
NCCEVN_CALL_STATUS_UPDATE	If call status information changes, the application receives this event. The event value field indicates the type of information that was changed. The application can then invoke **nccGetCallStatus** to get the updated information. This event can occur in any call state, as long as the line state is active. It is generated only if the NCC_REPORT_STATUSINFO bit is set in the NCC.START.eventmask parameter.
NCCEVN_CAPABILITY_UPDATE	The application receives this event when the capabilities of a protocol change. The event value field indicates the capability that changed. The application can call **nccQueryCapability** to determine the current set of protocol capabilities.

Event	Description
NCCEVN_EXTENDED_CALL_STATUS_UPDATE	The application receives this event when protocol-specific call status information changes. The event value field indicates the kind of information that was changed. The application can then call **nccGetExtendedCallStatus** to retrieve this information. This event is generated only if the NCC_REPORT_STATUSINFO bit is set in the NCC.START.eventmask parameter.
NCCEVN_INCOMING_CALL	Indicates that the NCC service detected an incoming call and all necessary call information (for example, digits) has been gathered. The call is now in the incoming call state. At this point, the application decides whether to accept, answer, or reject the call.
NCCEVN_LINE_IN_SERVICE	Indicates that an out-of-service line (a line in out-of-service line state) was placed in service. It is now in idle line state.
NCCEVN_LINE_OUT_OF_SERVICE	Indicates that a line was taken out of service. The event value field indicates the reason for taking the line out of service.
NCCEVN_PROTOCOL_ERROR	An error condition occurred. The call may be in an unusable state.
NCCEVN_PROTOCOL_EVENT	The protocol implementation generated an unsolicited event.
NCCEVN_RECEIVED_DIGIT	Indicates that a call address or subaddress digit has been received from the network. The application may receive several of these events, as digits are received in an overlapped fashion for an incoming call. The value field contains the digit. When the first digit is received, the call state changes from seizure to receiving digits. The call remains in this state until NCCEVN_INCOMING_CALL is received. This event is generated only if the NCC_REPORT_DIGITS bit is set in the NCC.START.eventmask parameter.
NCCEVN_REJECTING_CALL	Either of the following has occurred: • The application has invoked **nccRejectCall** to reject an incoming call. • The application has failed to accept, answer, or reject an incoming call within the period of time specified by the NCC.START.waitforPCtime parameter. The call enters the rejecting call state. The event value field contains the reason why the call was rejected.
NCCEVN_SEIZURE_DETECTED	Indicates that NCC has detected an incoming call. A call handle is created for the call. The call handle may now be used for all subsequent operations for this call. The new call begins in the seizure call state.

Retrieving call information

The following information is useful when developing applications that retrieve status information about existing calls:

- NCC functions for retrieving call information
- NCC_CALL_STATUS structure
- NCC_CAS_EXT_CALL_STATUS structure

NCC functions for retrieving call information

To get call status information, the application can use the following NCC functions:

Function	Description
nccGetCallStatus	Returns an NCC_CALL_STATUS structure containing basic information about the call, such as the DID and ANI information, and whether or not the call is on hold.
nccGetExtendedCallStatus	Returns an NCC_CAS_EXT_CALL_STATUS structure containing other information about the call. For NMS CAS, this information may include the user and toll category, and billing rate. The types of information received with this function differ from protocol to protocol.

Either of these synchronous functions can be invoked in any call state, as long as the line is in an active line state.

An application may also receive the unsolicited events NCCEVN_CALL_STATUS_UPDATE or NCCEVN_EXTENDED_CALL_STATUS_UPDATE while a particular call is still in progress. These events indicate a change in the status for the specified call. The application can examine the value field of the event for information about the type of status change that has occurred for the specific call. Then the application can invoke **nccGetCallStatus** or **nccGetExtendedCallStatus** to retrieve structures (NCC_CALL_STATUS or NCC_CAS_EXT_CALL_STATUS) that provide specific information about the call's status.

NCC_CALL_STATUS structure

nccGetCallStatus is a protocol independent NCC function that returns the following NCC_CALL_STATUS structure:

```
typedef struct
{
          DWORD size ;
          DWORD state;
          char calledaddr [NCC_MAX_DIGITS+1];
          char callingaddr[NCC_MAX_DIGITS+1];
          char callingname[NCC_MAX_CALLINGNAME];
          DWORD pendingcmd;
          DWORD held;
          DWORD direction;
          CTAHD linehd;
} NCC_CALL_STATUS;
```

The NCC_CALL_STATUS structure contains the following fields:

Field	Description
size	Number of bytes written at the address pointed to by status.
state	Current call state. Valid states are: NCC_CALLSTATE_INVALID NCC_CALLSTATE_SEIZURE NCC_CALLSTATE_RECEIVING_DIGITS NCC_CALLSTATE_INCOMING NCC_CALLSTATE_ACCEPTING NCC_CALLSTATE_ANSWERING NCC_CALLSTATE_REJECTING NCC_CALLSTATE_CONNECTED NCC_CALLSTATE_DISCONNECTED NCC_CALLSTATE_OUTBOUND_INITIATED NCC_CALLSTATE_PLACING NCC_CALLSTATE_PROCEEDING
calledaddr	For inbound calls, the address of the requested number if provided (for example, DID).
callingaddr	For inbound calls, the address of the caller, if provided (for example, caller ID, ANI).
pendingcmd	The last call control command issued that has not yet been acknowledged by the board. This field is set when a call control command is sent to the board, and cleared on the next event that corresponding to the acknowledgment of the pending command. Possible values are: (0) No command pending. NCC_PENDINGCMD_ACCEPT_CALL NCC_PENDINGCMD_ANSWER_CALL NCC_PENDINGCMD_AUTOMATIC_TRANSFER NCC_PENDINGCMD_DISCONNECT_CALL NCC_PENDINGCMD_HOLD_CALL NCC_PENDINGCMD_PLACE_CALL NCC_PENDINGCMD_REJECT_CALL NCC_PENDINGCMD_RELEASED_CALL NCC_PENDINGCMD_RETRIEVE_CALL NCC_PENDINGCMD_TRANSFER_CALL NCC_PENDINGCMD_SET_BILLING
held	Set to non-zero value when a call is held.
direction	Indicates inbound or outbound call. Possible values are: NCC_CALL_INBOUND NCC_CALL_OUTBOUND
linehd	Line (context) handle on which the call resides.

Note: NCC_CALL_STATUS fields are not guaranteed to be filled during call setup. The values of these fields depend on the information associated with the incoming call, and on the protocol used to set up the call.

NCC_CAS_EXT_CALL_STATUS structure

nccGetExtendedCallStatus returns the NCC_CAS_EXT_CALL_STATUS structure:

```
typedef struct
{
 DWORD size;
 char ANIpresentation;                    /* Set if the ANI presentation is restricted */
 char redirectingaddr [NCC_MAX_DIGITS+1]; /* Contains redirecting address information  */
 char redirectingreason;                  /* Contains the reason for redirection       */
 char usercategory;                       /* Contains the user category                */
 char tollcategory;                       /* Contains the toll category                */
 char carrierid [NCC_MAX_DIGITS+1];       /* Contains the carrier ID information       */
 WORD billingrate;                        /* Information passed with BILLING_SET event */
}NCC_CAS_EXT_CALL_STATUS;
```

The NCC_CAS_EXT_CALL_STATUS structure contains the following fields:

Field	Protocols that use the field	Description
ANIpresentation	MFC, EAM	Set if ANI presentation is restricted (caller ID information is restricted).
redirectingaddr	EUC (Sweden), LPS (with caller ID)	Redirecting number information (if the call has been redirected from another terminal).
redirectingreason	LPS (with caller ID)	Reason for call redirection (for example, busy, universal, or unanswered).
usercategory	MFC, EAM, R15, LPS (with caller ID)	Either the type of the calling party (for example, normal subscriber, operator, pay phone), or the type of call (protocol-specific).
tollcategory	MFC, EAM, LPS (with caller ID)	Generally the same as usercategory for MFC and EAM (it might be different for certain countries using the MFC-R2 protocol, if supported). For LPS, it is filled with the call qualifier information.
carrierid	FGD, LPS (with caller ID)	Carrier ID information. For LPS, it contains the first called line identity information.
billingrate	MFC, EAM	Indication if the current call is billed or free (for CAS protocols, the actual cost of an outbound call is calculated by counting billing pulses, if the network offers this service).

Note: Only a subset of NCC_CAS_EXT_CALL_STATUS fields are filled depending on the protocol used.

To verify whether specific fields are supported in your country, refer to:

- *BellCore caller ID data* on page 173
- *NTT (Japan) caller ID data* on page 176
- *ETSI (France) caller ID data* on page 174

nccPlaceCall and specifying extended information

With certain NMS CAS protocols, when an application attempts to place a call with **nccPlaceCall**, extended information can be sent with the call placement request. This information is included in the CAS_PLACECALL_EXT structure which is a component of the NCC_ADI_CAS_PARMS structure:

```
typedef struct
{
DWORD           size;
char            ANIpresentation;
BYTE            redirectingreason;
WORD            satellitecircuit;
char            redirectingaddr[33];
char            carrierid[33];
char            pad2[2];
INT16           usercategory;
INT16           tollcategory;
char            datetime[8];
char            callingname[32];
} CAS_PLACECALL_EXT;
```

In the function call, the NCC_ADI_CAS_PARMS structure is referenced using the void ***protcallparms*** argument.

The CAS_PLACECALL_EXT structure contains the following fields:

Field	Protocols that use the field	Description
size	All	Size of this structure.
ANIpresentation	MFC, EAM, STA	Set this parameter if ANI presentation is restricted (that is, caller ID information is restricted).
redirectingreason	LPS (with caller ID)	Reason for call redirection (for example, busy, universal, or unanswered).
satellitecircuit	MFC	Set this parameter if there is a satellite link in the circuit.
redirectingaddr	EUC, STA	Redirecting number information (if the call has been redirected from another terminal).
carrierid	FGD, STA	Carrier ID information.
usercategory	MFC, LPS (with caller ID), EAM, R15, STA	The type of the calling party (for example, normal subscriber, operator, pay phone), or the type of call (protocol-specific).
tollcategory	MFC, EAM, STA	Generally the same as usercategory, if supported. It can be different for certain countries using the MFC-R2 protocol.
datetime	STA	Date and time as MMDDhhmm.
callingname	STA	Calling party name.

nccDisconnectCall and specifying extended information

With certain NMS CAS protocols, when an application attempts to disconnect a call with **nccDisconnectCall**, extended information can be sent with the call disconnect request. This information is included in the CAS_DISCONNECT_EXT structure which is a component of the NCC_ADI_CAS_PARMS structure:

```
typedef struct
{
DWORD        size;                  /* size of this structure       */
WORD         cause;                 /* disconnect cause             */
WORD         pad;
} CAS_DISCONNECT_EXT;
```

In the function call, the NCC_ADI_CAS_PARMS structure is referenced using the void ***protcallparms*** argument.

The CAS_DISCONNECT_EXT structure contains the following fields:

Field	Protocols that use the field	Description
size	All	Size of this structure.
cause	WNK, STA	Disconnect cause. Determines the call progress tone sent to an off-hook, disconnected party.

nccRejectCall and specifying extended information

With certain NMS CAS protocols, when an application attempts to reject a call with **nccRejectCall**, extended information can be sent with the call reject request. This information is included in the CAS_REJECT_EXT structure which is a component of the NCC_ADI_CAS_PARMS structure:

```
ttypedef struct
{
DWORD           size;                  /* size of this structure       */
WORD            cause;                 /* reject cause                 */
WORD            pad;
}   CAS_REJECT_EXT;
```

In the function call, the NCC_ADI_CAS_PARMS structure is referenced using the void ***protcallparms*** argument.

The CAS_REJECT_EXT structure contains the following fields:

Field	Protocols that use the field	Description
size	All	Size of this structure.
cause	WNK, MFC	Reject cause. For MFC, this can be used to determine the Group B tone used to reject the call.

Determining the capabilities of a protocol

With the NCC service, an application can call **nccQueryCapability** to determine the capabilities of a protocol. **nccQueryCapability** returns a capabilitymask.

For more information, refer to *NMS CAS TCP call control capabilities* on page 45.

Receiving billing pulses

If the network provides the capability of receiving billing pulses, an outbound call receives billing pulses during the connected state. These are brief variations in the state of the signaling bits that signal that a unit of cost has been billed to the call. The actual price of a unit of cost changes from network to network, as does the frequency with which billing pulses are received.

An application placing outbound calls can set the bit NCC_REPORT_BILLING in the NCC.START.eventmask parameter to enable the reception of billing pulse events. These are presented as NCCEVN_BILLING_INDICATION events by Natural Access. The application can then count the events to calculate the cost of the call.

NMS CAS TCP call control capabilities

This topic provides an overview of the NCC capabilities associated with individual NMS CAS TCPs. For more information, refer to the *Natural Call Control Service Developer's Reference Manual* and to *NMS CAS protocols* on page 10.

AP2, EAM, EL7, EUC, EUC/SWE, FGD, GDS, and LPS

The following table shows the capabilities that the indicated protocols support:

Capability	AP2	EAM	EL7	EUC	EUC/ SWE	FGD	GDS	LPS
NCC_CAP_ACCEPT_CALL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NCC_CAP_SET_BILLING	No	Yes	No	No	No	No	No	No
NCC_CAP_OVERLAPPED_SENDING	Yes	Yes	No	Yes	Yes	Yes	No	No
NCC_CAP_HOLD_CALL	No	No	Yes	No	No	No	Yes	Yes
NCC_CAP_SUPERVISED_TRANSFER	No	No	Yes	No	No	No	Yes	Yes
NCC_CAP_AUTOMATIC_TRANSFER	No	No	Yes	No	No	No	Yes	Yes
NCC_CAP_EXTENDED_CALL_STATUS	No	Yes	No	No	Yes	Yes	No	Yes
NCC_CAP_SEND_CALL_MESSAGE	No	No	No	No	No	No	No	No
NCC_CAP_SEND_LINE_MESSAGE	No	No	No	No	No	No	No	No
NCC_CAP_HOLD_IN_ANY_STATE	No	No	No	No	No	No	No	No
NCC_CAP_DISCONNECT_IN_ANY_STATE	No	No	No	No	No	No	No	No
NCC_CAP_MEDIA_IN_SETUP	Yes	Yes	No	Yes	Yes	Yes	No	No
NCC_CAP_CALLER_ID	No	Yes	No	No	Yes	Yes	No	Yes

Note: The NCC_CAP_CALLER_ID capability is supported for France, Japan, and the US if the NCC.X.ADI_LPS.cidsupport parameter is set to 1.

MELCAS, NEC, MFC, MFS, OPS, R15, SS5, STA, and WNK

The following table shows the capabilities that the indicated protocols support:

Capability	MELCAS	NEC	MFC	MFS	OPS	R15	SS5	STA	WNK
NCC_CAP_ACCEPT_CALL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NCC_CAP_SET_BILLING	No	No	Yes	No	No	No	No	No	No
NCC_CAP_OVERLAPPED_SENDING	No	No	Yes	Yes	No	Yes	Yes	No	Yes
NCC_CAP_HOLD_CALL	Yes	Yes	No	No	Yes	No	No	Yes	Yes
NCC_CAP_SUPERVISED_TRANSFER	Yes	Yes	No	No	Yes	No	No	No	Yes
NCC_CAP_AUTOMATIC_TRANSFER	Yes	Yes	No	No	Yes	No	No	No	Yes
NCC_CAP_EXTENDED_CALL_STATUS	No	No	Yes	Yes	No	Yes	No	No	No
NCC_CAP_SEND_CALL_MESSAGE	No	No	No	No	No	No	No	No	No
NCC_CAP_SEND_LINE_MESSAGE	No	No	No	No	No	No	No	No	No
NCC_CAP_HOLD_IN_ANY_STATE	No	No	No	No	No	No	No	No	No
NCC_CAP_DISCONNECT_IN_ANY_STATE	No	No	No	No	No	No	No	No	No
NCC_CAP_MEDIA_IN_SETUP	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
NCC_CAP_CALLER_ID	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes

5 NCC parameters

NCC call control parameters

The behavior of many NCC functions, and of the operating protocol, is controlled by parameters. These parameters are grouped together into structures. Each parameter structure has a set of default values that is sufficient for many configurations. You can modify the parameters to:

- Enable or disable function features.
- Adapt the function for exceptional configurations.

For example, when recording voice data, you can alter the function's behavior by modifying any of the record parameters that specify:

- Any subset of DTMF keys entered by the telephone caller that abort the function.
- Gain applied to the input signal.
- An initial timeout, which defines the time during which the caller must start speaking before the operation terminates.
- The amount of silence after a caller has stopped speaking before the operation terminates.
- Record-sync prompt frequency, amplitude, and duration.
- Automatic gain control settings.

The following parameters are available for NMS CAS TCPs:

- NCC.X.ADI_START
- NCC.X.ADI_START.cleardown
- NCC.X.ADI_START.dial
- NCC.X.ADI_START.dtmfdet
- NCC.X.ADI_START.echocancel
- NCC.X.ADI_PLACECALL
- NCC.X.ADI_PLACECALL.callprog

Refer to *NMS CAS TCP call control capabilities* on page 45 for more information.

NCC.X.ADI_START

The following tables describes NCC.X.ADI_START parameters:

NCC.X.ADI_START				
Dependent function: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
mediamask	DWORD	0x001F	mask	Controls which functions will be running or reserved when the call enters the connected (conversation) state. (The NOCC protocol enters this state immediately.) Reserved indicates that the DSP MIPS have been committed to the operation before the operation has actually started. The application must reserve DSP resources in advance by using this parameter for DTMF detection, silence detection, cleardown detection, and echo cancellation. A value can be formed by using the OR operator with any of the following bit masks or by using one of the specified constants: • NCC_RESERVE_DTMF (0x0001): Reserve DTMF detection (not used for QX boards) • NCC_RESERVE_SILENCE (0x0002): Reserve cleardown detector (not used for QX boards) • NCC_RESERVE_CLEARDOWN (0x0004): Reserve DTMF detection (not used for QX boards) • NCC_AUTO_DTMF (0x0008): Start DTMF detection • NCC_AUTO_ECHO (0x0010): Start echo canceller • NCC_ALL_MEDIA (0x001F): (NCC_RESV_CLEARDOWN| NCC_RESV_SILENCE| NCC_RESV_DTMF| NCC_RESV_AUTO_DTMF| NCC_RESV_AUTO_ECHO) • NCC_ACCEPT_DTMF (0x100): DTMF detection in accept

NCC.X.ADI_START.cleardown

The following table describes NCC.X.ADI_START.cleardown parameters:

NCC.X.ADI_START.cleardown				
Dependent function: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
bandw1	DWORD	40	Hz	Bandwidth for first frequency of the cleardown detector. Valid range is 20 to 800.
bandw2	DWORD	40	Hz	Bandwidth for second frequency. Valid range is 20 to 800.
freq1	DWORD	350	Hz	First frequency to detect. Valid range is 1 to 4000.
freq2	DWORD	440	Hz	Second frequency to detect, or 0 if detecting single frequency. Valid range is 1 to 4000.
maxofftime	DWORD	0	ms	Maximum time tone may be OFF to qualify. For continuous tones, this parameter is ignored. For cadenced tones, the count is reset if the interval between any two tones is longer than this time. Valid range is 0 to 32767.
maxontime	DWORD	0	ms	Maximum time tone must be ON to qualify. For continuous tones, this parameter is ignored. For cadenced tones, the count is reset if any tone is longer than this time. Valid range is 0 to 32767.
minofftime	DWORD	0	ms	Minimum time tone must be OFF to qualify. For continuous tones, this parameter is ignored. For cadenced tones, the count is reset if the interval between any two tones is shorter than this time. Valid range is 0 to 32767.
minontime	DWORD	0	ms	Minimum time tone must be ON to qualify. For continuous tones, this parameter is ignored. For cadenced tones, the count is reset if any tone is shorter than this time. Valid range is 0 to 32767.
qualampl	INT32	-28	dBm	Minimum signal level recognized as a hang-up tone. Valid AG and CG range is -51 to -15. Valid QX range is -48 to 0.
qualtime	DWORD	1000	ms	Minimum duration of tone before a hang-up is recognized. The valid range is 0 to 32767. qualtime is ignored if tonecount is non-zero (cadenced tones).
reflevel	DWORD	0xB000	IDU	Do not modify.
reserved	DWORD	0	internal	Do not modify.
tonecount	DWORD	0	integer	Minimum number of cadenced tones detected before reporting the cleardown event. For continuous tones, set this parameter to 0.

NCC.X.ADI_START.dial

The following table describes NCC.X.ADI_START.dial parameters:

NCC.X.ADI_START.dial				
Dependent functions: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
breaktime	DWORD	60	ms	Break (on-hook) duration for dial pulses. Valid AG and CG range is 0 to 30000. Valid QX range is 0 to 32767.
dialtonewait	DWORD	5000	ms	Maximum time to wait for dial tone (applies only to the semicolon (;) character). Valid range is 0 to 65535.
dtmfampl1	INT32	-6	dBm	Amplitude of the low frequency component of the DTMF pair. Valid AG and CG range is -54 to -3. Valid QX range is -90 to 0.
dtmfampl2	INT32	-4	dBm	Amplitude of the high frequency component of the DTMF pair. Valid AG and CG range is -54 to -3. Valid QX range is -90 to 0.
dtmfofftime	DWORD	80	ms	Duration of the silence time between each digit. Valid AG and CG range is 0 to 65534. Valid QX range is 0 to 2047.
dtmfontime	DWORD	80	ms	Duration of each DTMF or MF digit. Valid AG and CG range is 0 to 65534. Valid QX range is 0 to 2047.
flashtime	DWORD	500	ms	Amount of time to assert the on-hook signaling pattern for a flash (!) character. Valid AG and CG range is 0 to 65535. Valid QX range is 0 to 32767.
interpulse	DWORD	700	ms	Inter-digit time for pulsed dialing. Valid AG and CG range is 0 to 30000. Valid QX range is 0 to 32767.
longpause	DWORD	5000	ms	Amount of delay associated with the period (.) character. Valid range is 0 to 65535.
maketime	DWORD	40	ms	Make (off-hook) duration for dial pulses. Valid AG and CG range is 0 to 30000. Valid QX range is 0 to 32767.
method	DWORD	0	mask	Type of signaling: 0=DTMF, 1=Pulse, 2=MF (US).
reserved	DWORD	0	internal	Do not modify.
shortpause	DWORD	2000	ms	Amount of delay associated with the comma (,) character. Valid range is 0 to 65535.
tonebandw1	DWORD	40	Hz	Bandwidth of the first frequency of the dial tone detector. Valid AG and CG range is 20 to 800. Valid QX range is 40 to 2000.
tonebandw2	DWORD	40	Hz	Bandwidth of the second frequency of the dial tone detector. Valid AG and CG range is 20 to 800. Valid QX range is 40 to 2000.

NCC.X.ADI_START.dial				
Dependent functions: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
tonefreq1	DWORD	350	Hz	First (or only) dial tone frequency. Valid AG and CG range is 330 to 3600. Valid QX range is 1 to 4000.
tonefreq2	DWORD	440	Hz	Second dial tone frequency. Set this to 0 to detect a single frequency. Valid AG and CG range is 330 to 3600. Valid QX range is 1 to 4000.
tonequalampl	INT32	-28	dBm	Minimum broadband signal amplitude to qualify for dial tone detection. Valid AG and CG range is -40 to 0. Valid QX range is -48 to 0.
tonequaltime	DWORD	50	ms	Minimum duration of a qualified tone to be considered dial tone. Valid range is 0 to 32767.
tonereflevel	DWORD	0xb000	IDU	Do not modify.
tonetotaltime	DWORD	0	ms	Total time interrupted dialtone must be present.

NCC.X.ADI_START.dtmfdet

The following table describes NCC.X.ADI_START.dtmfdet parameters:

NCC.X.ADI_START.dtmfdet				
Dependent function: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
columnfour	DWORD	1	mask	Flag that indicates whether to detect the A, B, C, and D DTMF digits. Set this to 1 to detect these, or 0 to ignore them.
offqualampl	INT32	-45	dBm	Minimum signal required to maintain recognition of a DTMF signal once recognition has started. Valid AG and CG range is -51 to -15. Not used for QX boards.
offqualtime	DWORD	40	ms	Minimum duration of absence of a recognized DTMF signal before an end-of-digit event is emitted. Valid AG and CG range is 5 to 32767. Valid QX range is 0 to 32766.
offthreshold	DWORD	0x92e0	IDU	Do not modify.
onqualampl	INT32	-39	dBm	Minimum signal level recognized as a DTMF signal. Valid AG and CG range is -51 to -15. Not used for QX boards.
onqualtime	DWORD	50	ms	Minimum duration of a recognized DTMF signal before a digit event is emitted. Valid AG and CG range is 22 to 32767. Valid QX range is 0 to 32766.
onthreshold	DWORD	0xcab0	IDU	Do not modify.

NCC.X.ADI_START.echocancel

The following table describes NCC.X.ADI_START.echocancel parameters:

NCC.X.ADI_START.echocancel				
Dependent functions: nccStartProtocol				
Field	**Type**	**Default**	**Units**	**Description**
adapttime	DWORD	0	ms	Echo canceller adaptation time for MODE=2. The valid AG and CG range is 100 to 1000. Smaller values require more DSP processing power. Not used for QX boards.
filterlength	DWORD	0	ms	Filter length of echo canceller for MODE=2. Valid range is 2 to 20. Greater values require more DSP processing power.
gain	INT32	0	dB	Amount of amplification applied to echo cancelled output. Valid AG and CG range is -54 to 24. Done by the AGC module for QX boards.
mode	DWORD	0	integer	Controls echo canceller operation: A value can be formed by using the OR operator with any of the following bit masks or by using one of the specified constants: NCC_ECHOCANCEL_DEFAULT (1): Choose the default length and adapt time based on board type. (For AG 4000/C and AG 4040/C boards, the default is for no echo cancel.) For more information, see the *ADI Service Developer's Reference Manual*. NCC_ECHOCANCEL_CUSTOM (2): Use specified length and adapt time. Default = 0: No echo cancellation.
predelay	DWORD	0	ms	Output sample delay. Valid range is 0 to 9.

NCC.X.ADI_PLACECALL

The following table describes NCC.X.ADI_PLACECALL parameters:

NCC.X.ADI_PLACECALL				
Dependent functions: nccPlaceCall, nccAutomaticTransfer				
Field	**Type**	**Default**	**Units**	**Description**
connectmask	DWORD	0x0103	mask	Controls which network events cause an outgoing call to transition to the connected state. A value can be formed by using the OR operator with any of the following bit masks: • NCC_CON_ON_SIGNAL (0x0001): Out-of-band signal • NCC_CON_ON_VOICE_BEGIN (0x0002): Voice detected • NCC_CON_ON_VOICE_MEDIUM (0x0004): Medium length voice • NCC_CON_ON_VOICE_LONG (0x0008): Long voice • NCC_CON_ON_VOICE_EXTENDED (0x0010): Extended voice • NCC_CON_ON_VOICE_END (0x0020): Voice ended • NCC_CON_RING_QUIT (0x0080): Ring ended • NCC_CON_ON_CED (0x0100): Modem detected • NCC_CON_ON_DIALTONE (0x0200): Dial tone • NCC_CON_ON_SIT (0x0400): SIT detected • NCC_CON_ON_RING_BEGIN (0x0800): Connect immediately • NCC_CON_ON_PROCEEDING (0x8000): Connect immediately

NCC.X.ADI_PLACECALL				
Dependent functions: nccPlaceCall, nccAutomaticTransfer				
Field	**Type**	**Default**	**Units**	**Description**
disconnectmask	DWORD	0x0040	mask	Controls which network events cause an outgoing call to disconnect (not complete). A value can be formed by using the OR operator with any of the following bit masks: • NCC_DIS_ON_VOICE_BEGIN (0x0002): Voice detected • NCC_DIS_ON_VOICE_MEDIUM (0x0004): Medium length voice • NCC_DIS_ON_VOICE_LONG (0x0008): Long voice • NCC_DIS_ON_VOICE_EXTENDED (0x0010): Extended voice • NCC_DIS_ON_VOICE_END (0x0020): Voice ended • NCC_DIS_ON_TIMEOUT (0x0040): Call progress timeout • NCC_DIS_ON_RING_QUIT (0x0080): Call progress ring quit • NCC_DIS_ON_CED (0x0100): Dial tone • NCC_DIS_ON_RING_BEGIN (0x0800): Call progress ring begin

NCC.X.ADI_PLACECALL.callprog

The following table describes NCC.X.ADI_PLACECALL.callprog parameters:

NCC.X.ADI_PLACECALL.callprog				
Dependent functions: nccPlaceCall, nccAutomaticTransfer				
Field	**Type**	**Default**	**Units**	**Description**
busycount	DWORD	4	count	Number of non-precise busy tones that must occur before busy or fast busy is reported. Valid range is 1 to 32767.
leakagetime	DWORD	8	ms	Do not modify.
maxbusy	DWORD	1500	ms	Threshold time defining the total time period (on time plus off time) for distinguishing between slow busy and ringing tone. Valid range is 0 to 32767.
maxreorder	DWORD	700	ms	Threshold time defining the total time period (on time plus off time) for distinguishing between fast busy (reorder) and slow busy. Valid range is 0 to 32767.
maxring	DWORD	3000	ms	Maximum duration of a tone to distinguish a ringing tone from a dial tone. Valid range is 0 to 32767.
maxringperiod	DWORD	8000	ms	Length of time of the last ringing tone plus the silence that follows, before call progress reports a ringing-ended event. Valid range is 0 to 32767.
noiselevel	DWORD	0x14000	IDU	Do not modify.
precmask	DWORD	7	mask	Mask to control which precise detectors to run. A value can be formed by using the OR operator with any of the following bit masks: • NCC_CPMSK_PRECISE_CED (0x0001): CED tone modem • NCC_CPMSK_PRECISE_SIT (0x0002): SIT • NCC_CPMSK_PRECISE_BUSY (0x0004): Busy and reorder tone (US) • NCC_CPMSK_PRECISE_425 (0x0008) 425 Hz tone (busy and reorder tone, non-US) • NCC_CPMSK_PRECISE_SITEXT (0x0010): SIT type reporting • NCC_CPMSK_PRECISE_TDD (0x0020): TDD/TTY device • NCC_CPMSK_PRECISE_NU (0x0040): Unassigned number Only three of the four detectors can run concurrently. If all four detectors are specified, busy and reorder tones are determined by cadence alone, and only the SIT, CED, and TDD/TTY detectors are enabled. Busy and reorder tone (bit value 0x0004) and the 425 Hz tone selection (bit value 0x0008) are mutually exclusive. If you choose both, only the 425 Hz filter takes effect.

NCC.X.ADI_PLACECALL.callprog				
precqualtime	DWORD	150	ms	Precise tone qualification time. All precise tones must be longer than this value to qualify. Valid range is 0 to 32767.
qualtonetime1	DWORD	60	ms	Do not modify.
qualtonetime2	DWORD	80	ms	Do not modify.
qualvoicetime1	DWORD	60	ms	Do not modify.
qualvoicetime2	DWORD	60	ms	Do not modify.
ringcount	DWORD	7	count	The number of ring tones that must occur before NO_ANSWER is reported. Valid range is 1 to 32767.
silencelevel	INT32	-40	dBm	Maximum signal level that is considered to be silence. Valid AG and CG range is -46 to -34. Valid QX range is -45 to 0.
silencetime	DWORD	1500	ms	Minimum length of a silent period after voice is detected before call progress reports a voice-ended event.
stopmask	DWORD	0	mask	Mask to control which events cause call progress to stop. A value can be formed by using the OR operator with any of the following bit masks or by using one of the specified constants: • NCC_CPSTOP_ON_RINGTONE (0x0000): Ring tone • NCC_CPSTOP_ON_RINGQUIT (0x0002): Ring end • NCC_CPSTOP_ON_VOICE_BEGIN (0x0004): Ring end • NCC_CPSTOP_ON_VOICE_MEDIUM (0x0008): Medium voice duration • NCC_CPSTOP_ON_VOICE_LONG (0x0010): Long voice duration • NCC_CPSTOP_ON_VOICE_EXT (0x0020): Extended voice duration • NCC_CPSTOP_ON_VOICE_END (0x0040): Voice end
timeout	DWORD	10000	ms	Maximum time that can elapse with no stimulus from the network before call progress stops with reason of timeout. If the value is set to zero, the timer is disabled.
voicextended	DWORD	9000	ms	Minimum length of time voice must be detected before call progress reports an extended-voice event.
voicelong	DWORD	6000	ms	Minimum length of time voice must be detected before call progress reports a long-voice event.
voicemedium	DWORD	3000	ms	Minimum length of time voice must be detected before call progress reports a medium-voice event.
voicetoneratio	DWORD	0x30000	IDU	Do not modify.

6 Gateway application call control

Call control and gateway applications

Gateway applications perform call control for calls that must be switched between separate trunks. They perform a switch-like function, such as directing inbound calls from the PSTN to appropriate addresses on an internal network (the application may also be embedded in the PSTN itself). Typically, these applications receive inbound calls, analyze the incoming addresses, and then place calls to the specified addresses.

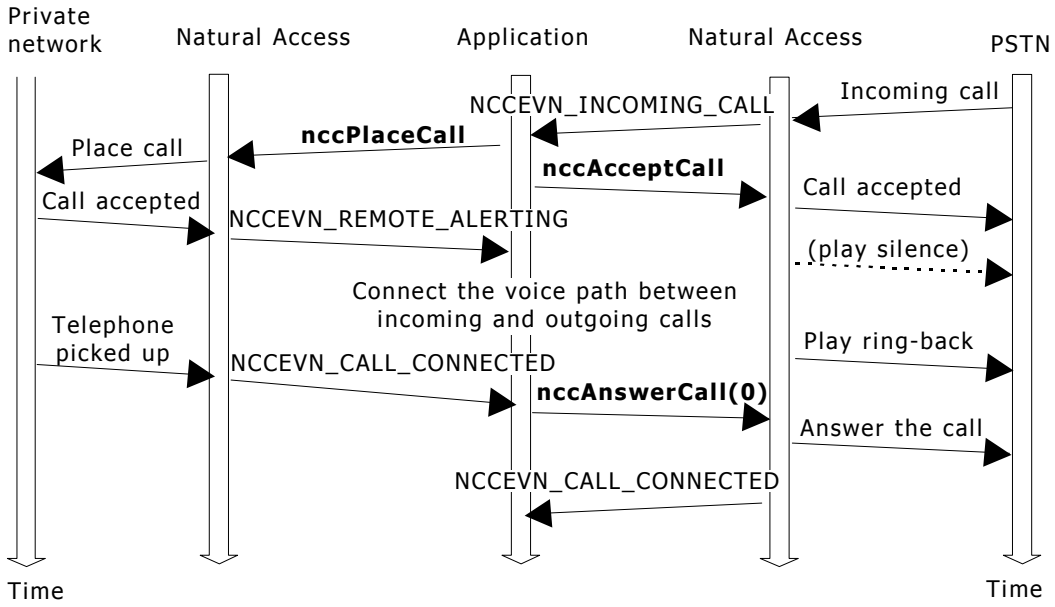
Accepting and rejecting calls with gateway applications can pose problems because the decision to accept or reject an incoming call depends on the status of the associated outbound call. However, the time available in the incoming call protocol to accept the call can be shorter than the setup time for the corresponding outgoing call. For more information about gateway call control, refer to *Accepting calls through gateway applications* on page 60 and *Rejecting calls through gateway applications* on page 61.

Accepting calls through gateway applications

A gateway switching application goes through the following phases when accepting a call:

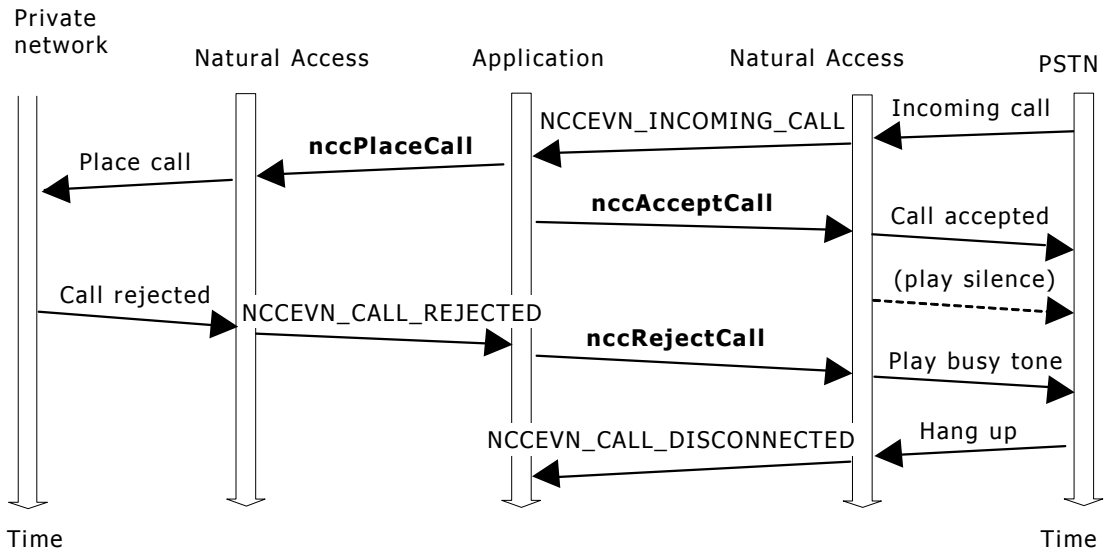
Phase	Description
1	The inbound side of the application receives a call.
2	The call is put on hold by accepting the call with **nccAcceptCall** and outputting silence on the line and the outbound side of the application dials the received address.
3	When the outbound side of the application receives an indication that the called terminal is free and ringing, it connects the voice path so that the caller hears the ringing tone from the called equipment.
4	When the outbound call is answered, the application also answers the inbound call with no rings, instructing the TCP to send the answer signal to the network immediately. Both calls are now in a connected state.

The following illustration shows how gateway applications accept inbound calls:



Rejecting calls through gateway applications

When a gateway application places an outbound call in response to inbound calls on another trunk, the call may be rejected for a variety of reasons. When this happens, the application must also reject the corresponding inbound call. The following illustration shows how this process works:



The way a gateway application rejects calls is similar to the way it accepts calls. Initially, the TCP accepts the incoming call and puts it on hold by sending silence to the line. When the outbound call is rejected, the application calls **nccRejectCall**. The TCP immediately starts to perform the action requested by **nccRejectCall**. It can play a busy tone, or let the application play a reject message. The TCP then relies on the caller side to tear down the connection.

7 Analog loop start (LPS) protocols

LPS signaling

The analog loop start protocol (LPS) is implemented by the LPS0 TCP. The analog variations act much like a telephone terminal, connected to a local switch or PBX through a local loop. These variations run on AG 2000/C analog line interface boards.

The following tables describe analog loop start signaling. Two tables are necessary, because the protocol changes depending on the side that started the call.

This topic describes LPS signaling in the following cases:

- The switch presents the call to the terminal equipment
- The terminal equipment places the call

Switch presenting calls to terminal equipment

The following table describes the case where the switch presents the call to the terminal equipment:

State	Outbound switch	Line	Inbound terminal
Idle		No loop current	
Ringing	Apply ringing voltage	Ringing voltage	(Telephone rings)
After the first ring, the network can send caller ID information on the line using modem tones. The LPS TCP can detect caller ID, following specifications for USA, France, and Japan. At this point, the incoming call is presented to the application, which can answer it or reject it. If the call is answered, the LPS TCP picks up the phone.			
Answer - conversation state		Loop current	Off-hook
If the inbound side application rejects the call, the LPS TCP does not pick up the phone, and eventually the calling party abandons the call. While the call is in conversation state, if it is connected to a PBX that supports this feature, the call can be transferred to a different extension. Different PBXs support transferring calls in different ways (the usual way is to send a flash, then dial the required extension). A parameterized sequence of actions is executed by the LPS TCP to transfer the call.			
Clear		Loop current interruption or cleardown tone	
Idle		No loop current	

Terminal equipment placing calls

The following table describes the case where the terminal equipment places the call:

State	Outbound terminal	Line	Inbound switch
Idle		No loop current	
Seizure	Off-hook	Loop current	
Seizure acknowledge		Dial tone	
The outbound side starts to send the address information through DTMF tones or by decadic pulses. If the method is decadic pulses, the loop current is switched on (pulse on) and off (pulse off) repeatedly to signal the digits.			
Call progress tones		Ring tone	
If the called terminal rejects the call, the LPS TCP detects the busy tone on the line, and abandons the call. If the called terminal does not answer, the TCP abandons the call after a parameterized number of rings.			
Answer - conversation state		Voice	(Someone has answered)
While the call is in conversation state, if it is connected to a PBX that supports this feature, the call can be transferred to a different extension. Different PBXs support transferring calls in different ways. The usual way is to send a flash, then dial the required extension. A parameterized sequence of actions is executed by the LPS TCP to transfer the call.			
Clear		Loop current interruption, or cleardown tone	
Idle		No loop current	

LPS editable parameters

To program the analog loop start TCP to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_LPS. You can modify parameters that modify unregulated features or features that can change from switch to switch within the same network.

The following table lists analog loop start parameters (within the parameter category NCC.X.ADI_LPS) that you can modify:

Field	Type/Unit	Default	Description
cidsupport	mask	0	Flag to enable caller ID detection. 0 - No caller ID 1 - Caller ID detection enabled The board keyword file must include the DSP file *adsir.m54* when caller ID is enabled.
cleardownflag	mask	1	Selects whether to run the cleardown tone detector in conversation state. 1 - Cleardown enabled 0 - Not enabled

Field	Type/Unit	Default	Description
connstring	string[6]	!	String for transfer back to the connected state with the first call. It is dialed if a call transfer fails, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
nodialtoneaction	integer	0	Selects what to do if no dial tone is detected. 0 - Hang up and abandon the call 1 - Proceed to dial anyway 2 - Generate an inbound call event
reversalmode	integer	0	Selects loop current reversal detection mode. 0 - Disable detection 1 - Reversal indicates remote answer 2 - Reversal indicates remote hang up 3 - Reversal indicates answer and hang up
ringstoincoming	count	0	Number of rings to detect for an inbound call. If 0, the TCP generates an inbound call event upon beginning of the first ring, otherwise it sends the event at the end of the selected number of rings. If caller ID is enabled (cidsupport = 1), the inbound call is reported after at least one ring. 0 - 1st ring begins 1 - 1st ring ends # ***n*** - After ***n*** rings
xferstring	string[6]	!;	Prefix dial string for call transfer. The string is dialed before dialing the number, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
xfersupport	mask	1	Flag to select whether PBX transfer is enabled. 0 - Transfer commands are disabled 1 - Transfer commands are enabled

String parameters occupy more than one index in the parameters list. Since the parameter list unit is WORDs (two bytes each), a string of maximum 6 characters occupies 3 indices.

Refer to *LPS non-editable parameters* on page 66 for more information.

LPS non-editable parameters

This topic describes parameters that are signaling specific.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/Unit	Default	Description
CIDalertmaxtime	ms	0	Maximum duration of an alert signal in caller ID protocol (if CID is enabled).
CIDmaxwaittime	ms	8000	Maximum time to wait for caller ID to arrive before concluding the caller has hung up (if CID is enabled).
CIDminmarktime	ms	100	Minimum duration of the mark signal of the caller ID protocol that is interpreted as such.
CIDtype	integer	0	Type of caller ID protocol, if CID is enabled: 0 - BellCore CID protocol 1 - NTT Japan CID protocol 2 - ETSI Ringing Pulse Alerting Signal CID protocol
dialtonemintime	ms	1000	For outgoing calls, the minimum duration of non-precise dial tone required before dialing will begin. Set this to 0 to disable non-precise dial tone detection. (Precise dial tone detection is controlled by NCC.START parameters). To comply with CTR21 standards, do not modify GER, GBR, or FRA parameters.
dialtonewaittime	ms	5000	For outgoing calls, the maximum time to wait for initial dial tone. To comply with CTR21 standards, do not modify GER, GBR, or FRA parameters.
freqdeglitchtime	count	26	For frequency-selective ring detection, deglitch time in 1/8 ms. Range is 2 to 80 (0.25 to 10 ms).
freqringhigh	Hz	54	For frequency-selective ring detection, the maximum frequency recognized. To comply with CTR21 standards, do not modify GER, GBR, or FRA parameters.
freqringlow	Hz	16	For frequency-selective ring detection, the minimum frequency recognized. To comply with CTR21 standards, do not modify GER, GBR, or FRA parameters.
freqringperiods	count	4	For frequency-selective ring detection, number of periods of the ring frequency needed to qualify. Range is 1 to 8.
freqtolerance	percentage	10	For frequency-selective ring detection, frequency tolerance.
interringmaxtime	ms	8000	Maximum length of an incoming ring period (on time + off time) that can elapse before the call is considered to be abandoned.
polaranswertime	ms	0	Wait time after going off-hook answering a call before the TCP starts detecting the loop current polarity reversal on far-end disconnect (if reversalmode = 2 or 3).

Field	Type/Unit	Default	Description
polardialtime	ms	0	Wait time after dialing before starting the loop current polarity reversal detection (if reversalmode = 1 or 3).
qualloopoff	ms	10	Minimum duration of loop current interruption before a hang up is recognized.
qualreversal	ms	200	Qualification time for loop current reversal event.
qualringoff	ms	100	For voltage-sensitive ring detection, the minimum duration of loss of detected voltage to be recognized as the end of a ringing signal.
qualringon	ms	6	For voltage-sensitive ring detection, the minimum duration of detected voltage to be recognized as the start of a ringing signal.
releaseguardtime	ms	1000	If the host places a call immediately after releasing a call, the line is not taken off-hook until this time has elapsed, to ensure that the CO considers the line idle. To comply with CTR21 standards, do not modify GER parameter.
ringdetectmode	mask	1	Selects whether the ring detector is voltage-sensitive or frequency-selective: 0 - Voltage-sensitive 1 - Frequency-selective
ringsigmaxtime	ms	3000	Maximum duration of a detected incoming ringing signal before the ringing is considered to be too long.
ringsigmintime	ms	100	Minimum duration of a detected ring signal before the ring signal is considered valid.

Refer to *LPS editable parameters* on page 64 for more information.

LPS and NCC service call control

This topic describes how to perform the following tasks while using NCC service call control with the LPS protocol:

- Using release guard
- Transferring calls on loop start lines
- Using loop current reversal parameters
- Using caller ID

Using release guard

If you place a call immediately after releasing a call, the line is not taken off-hook until sufficient time has elapsed to ensure that the COs consider the line idle after the previous call. The release guard is controlled by the NCC.X.ADI_LPS.releaseguardtime parameter.

Note: The LPS0 TCP queues a command to place a call during this period and proceeds with dialing when the release guard time expires.

Transferring calls on loop start lines

Call transfer operations use many of the same parameters as outbound call placement operations. These parameters are stored in the NCC_ADI_PLACECALL_PARMS and NCC_ADI_CALLPROG_PARMS structures. For details about the parameters stored in these structures, refer to the *Natural Call Control Service Developer's Reference Manual*.

Modify the NCC.X.ADI_LPS.connstring or NCC.X.ADI_LPS.xferstring parameters to specify additional parameters with the loop start protocol that control prefix dial strings for transfer and reconnect.

When in the connected state, if an attempt is made to transfer a call, and transfer is enabled (NCC.X.ADI_LPS.xfersupport = 1), the TCP executes the commands contained in the string specified by the xferstring parameter before dialing the called address that was passed to **nccAutomaticTransfer**.

If the dial fails, NCCEVN_CALL_DISCONNECTED is sent up to the host, with reason NCC_DIS_DIAL_FAILURE (or NCC_DIS_NO_DIALTONE if dialtone was expected but not present). The protocol then returns to the connected state. When returning to the connected state, the second string specified by the connstring parameter is dialed.

Using loop current reversal parameters

Some networks reverse the tip and ring polarity on the line when the far-end party hangs up. You can enable detection of loop current reversal events indicating far-end disconnects by setting the reversalmode parameter in the protocol parameter file.

If detection of loop current reversal on far-end hang-up is enabled, the TCP sends the NCCEVN_CALL_DISCONNECTED event to the application after the called party hangs up. Then the application should call **nccReleaseCall** to return to the idle state.

Caution:	Enable loop current reversal events only if the network provides this service. Otherwise, the TCP may operate incorrectly.

If you are connected to a network that is equipped to reverse the tip and ring polarity to indicate the far end positive answer and/or disconnect events, you can make these events available to the protocol by setting the NCC.X.ADI_LPS.reversalmode parameter to one of the following:

Value	Description
0	Disable the loop current polarity reversal detection.
1	Indicate remote answer if the switch reverses polarity.
2	Indicate remote hang-up if the switch reverses polarity.
3	Indicate both remote answer and hang-up if the switch reverses polarity twice.

If the polarity reversal detection is used as a far-end answer indication (reversalmode is set to 1 or 3), wait for some time after the dialing period before starting the detector. Since the wait time duration depends on the switch you are connected to, you may need to modify the NCC.X.ADI_LPS.polardialtime parameter to adjust to the switch conditions.

If you use the polarity reversal to indicate the far-end hang-up (reversalmode is set to 2 or 3), some time should elapse after establishment of the loop condition and before starting the detector. You may need to adjust this time interval to the switch conditions by setting the NCC.X.ADI_LPS.polaranswertime parameter with the appropriate value.

Using caller ID

Users of loop start trunks can subscribe to caller ID service. Caller ID information transfer is performed by using modem tones on the line at different times during the call set up. Different protocols are used in different countries to transfer caller ID information.

Note: Protocol parameters that control caller ID information are set in the CAS protocol country-specific parameter file. These should not be modified.

For information on the CID files supported for particular countries, refer to:

- *BellCore caller ID data* on page 173
- *NTT (Japan) caller ID data* on page 176
- *ETSI (France) caller ID data* on page 174

To enable your application to receive caller ID information, complete the following steps:

Step	Action
1	Edit the *ag.cfg* file to include the following statement : `AG2DSPfile = adsir.m54` (for AG 2000/C boards)
2	Enable caller ID TCP functionality by setting NCC.X.ADI_LPS.cidsupport = 1.
3	Do not change the NCC.X.ADI_LPS.CIDtype parameter. This parameter is set to the following values for different countries: **Value** / **Description** 0 — BellCore CID protocol. Data transmission occurs during the first long silent period between two ring patterns. Both multiple and single message formats are supported by the protocol. 1 — NTT Japan CID protocol. Line reversal followed by CAR alerting signal precedes FSK modulation transmission. Normal rings start after data transmission. The protocol supports the multiple message format. 2 — ETSI ringing pulse alerting signal CID protocol. Ringing pulse alert signal precedes FSK modulation transmission. Normal rings start after data transmission. The protocol supports the multiple message format. Used in France. Protocol parameters that control this behavior are set in the CAS protocol country-specific parameter file. These should not be modified.
4	Respond to NCCEVN_INCOMING_CALL events by invoking **nccGetCallStatus** to retrieve caller ID data. Because the caller ID data is stored in the NCC_CALL_STATUS structure (on a call-by-call basis), applications must analyze the call status of every incoming call to retrieve caller ID information.

See *NMS CAS TCP call control capabilities* on page 45 for information about country-specific caller ID fields that the software can recognize (if the user subscribes to the CID service).

8 Australian P2 (AP2) protocol

AP2 signaling

The AP2 TCP implements the specifications of the Telstra CAS protocol P2. This protocol is widely used in Australia to connect PBXs to the PSTN, for Telstra and other carriers.

The Australian P2 protocol uses the line signaling scheme specified by the CCITT for the MFC-R2 protocol (Recommendation Q.421). Two bits are used for each direction. The signaling channels supporting the line signaling of these protocols are referred to as A_f and B_f in the forward direction, and A_b and B_b in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment). The C and D bits are never used. Their value is fixed at 0 and 1 respectively.

The following table describes the signaling states of a typical call:

State	Outbound A_fB_f	Direction	Inbound A_bB_b
Idle	10	← →	10
Seizure	00	→	10
Seizure acknowledged	00	←	11
The outbound side sends the address information using in-band DTMF tones or decadic pulses. If decadic pulses are used, the A_f bit pulses on and off to signal the address digits. If, after all the address information has been transferred, the inbound side accepts the call, it plays a ring tone on the line, and then signals that the call has been answered by setting the A_b bit to 0.			
Ringing	00	←	11
Answer - conversation state	00	←	01
If the inbound side rejects the call, the outbound side clears forward by setting the A_f bit to 1. The inbound side goes back to idle by setting the B_b bit to 0.			
Clear forward	10	→	11
Idle	10	←	10
During conversation the outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. The bit used to carry a billing pulse depends on national specifications.			
Answer - conversation state	00	←	01
Billing pulses	00	←	11 or 00
Answer - conversation state	00	←	01
Depending on which side hangs up the call first, either a clear back signal or a clear forward signal is generated. Depending on national specifications, there might be a period of time during which the inbound side holds a release guard state, which is the same as clear back but happens when the outbound side is already in the idle state. Idle follows.			
Inbound hangs up first: Clear back	00	←	11
Clear forward	10	→	11
Idle	10	← →	10
Outbound hangs up first: Clear forward	10	→	01
Release guard	10	←	11
Idle	10	← →	10

The AP2 protocol uses either in-band DTMF tones or out-of-band decadic pulses to transfer register signaling information.

This protocol transfers only DID (direct inward dialing - the called address) information. To do this, the outbound side sends either a stream of DTMF tones or a sequence of decadic pulses to the inbound side, then considers the dialing done and waits for some confirmation from the inbound side. This register signaling technique,

in which the outbound side has no acknowledgment from the inbound side until the dialing is finished, is called digit spill.

AP2 parameters

To program the AP2 TCP to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_AP2. You can modify parameters that program TCP/host interaction, configure unregulated features, or configure features that can change from switch to switch within the same network.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

The following table describes the NCC.X.ADI_AP2 parameters (within the parameter category NCC.X.ADI_AP2):

Field	Unit	Default	Description
trunkdirection	mask	0x0	Determines trunk direction: 0 - Bidirectional 1 - Inbound only (no calls can be placed on it) 2 - Outbound only (no calls can be received on it)
startselectionduration	ms	150	Duration of proceed select pulse.
dialtoneseizureack	mask	0	Dial tone response to incoming seize.
maxwaitforfirstdigit	ms	15000	Maximum time to wait for first digit.
maxwaitfornextdigit	ms	3000	Maximum time to wait for next digit.
maxDIDdigits	count	7	Maximum number of DID (called) digits.
endofDIDtone	mask	0x00	Tone that terminates DID digits.
endselafterendtone	mask	0	Set to 1 to send end select pulse after receiving end of digits tone.
endselbeforeANIreq	mask	0	Set to 1 to send end select pulse before ANI request pulse.
endselectionduration	ms	120	Duration of end of selection pulse.
ANIrequestduration	ms	140	Duration of ANI request pulse.
maxANIdigits	count	7	Maximum number of ANI (calling) digits.
endofANItone	mask	0x00	Tone that terminates ANI digits.
meteringduration	ms	120	Duration of billing pulse.
waitingplaybusy	mask	0x1	This parameter and the waitingplayreorder parameter specify what to play as the cleardown tone (the tone the TCP plays when an inbound call is released and the calling party has not hung up yet). If this parameter is 1 and waitingplayreorder is 0, the busy tone is used as the cleardown tone. If neither of the parameters is set, the TCP remains silent.
waitingplayreorder	mask	0x0	This parameter and the waitingplaybusy parameter specify what to play as the cleardown tone. If this parameter is 1, the fast busy (reorder) tone is used as the cleardown tone. If neither of the parameters is set, the TCP remains silent.

Field	Unit	Default	Description
detectnetworkaudio	mask	0x0	Not used.
releaseguardtime	ms	1000	Minimum time the release guard signal must be applied.
seizureacktime	ms	10000	Outbound: Specifies time to wait for seizure acknowledgment after seizing the line.
nodialtonecontinue	mask	0x0	Continue dialing if no dial tone.
dialpulsemethod	mask	0	Determines the dialing type: 0 - DTMF dialing 1 - Decadic dialing
timewaitANIrequest	ms	800	Maximum time to wait for ANI request.
usercategory	mask	0x00	ASCII user category or 0x00 if none.
tollcategory	mask	0x00	ASCII toll category or 0x00 if none.
errorearlyanswer	mask	0	If this parameter is set to 1, an answer signal before all digits have been dialed is an error, and the TCP clears the call.
answerwaittime	count	90	Not used.
bitqualtime	ms	20	Specifies the qualification time for bit changes. A or B bit must be ON/Off of this duration to be qualified.
forwardpatterns1	mask	0x9119	Bit patterns used in the forward direction (outbound): addr/ring/seize/idle. Do not modify.
forwardpatterns2	mask	0x1111	Bit patterns used in the forward direction (outbound): unused/unused/rering/trkoffer. Do not modify.
backwardpatterns1	mask	0xDDDD	Bit patterns used in the backward direction (inbound): ani/endsel/proceed/szack. Do not modify.
backwardpatterns2	mask	0x9D5D	Bit patterns used in the backward direction (inbound): recall/meter/answer/cong. Do not modify.
backwardpatterns3	mask	0xDDD5	Bit patterns used in the backward direction (inbound): block/frcdisc/clrback/MCTon. Do not modify.
backwardpatterns4	mask	0xD95D	Bit patterns used in the backward direction (inbound): unused/idleback/answerfree/MCToff. Do not modify.
NMScountry	count	0	Not used.
permanentsignaltime	count	60	Time (in seconds) waiting for idle, after which we go out of service.

AP2 and NCC service call control

When applications perform NCC service call control with the AP2 protocol, they can receive digits in the following ways:

Method for receiving digits	Description
All at once	With the AP2 TCP, after NCCEVN_INCOMING_CALL is received, the calledaddr field in the NCC_CALL_STATUS structure contains all received digits. The callingaddr, usercategory and tollcategory fields are NULL. The parameter NCC.X.ADI_AP2.digitnumber determines the number of digits the TCP should expect from the calling party. The default is 7.
One at a time	To receive digits one at a time, make sure the Ncc.Start.OverlappedReceiving parameter is set. The AP2 TCP does not recognize ANI or category digits. Digits are presented in the order in which they arrive. The NCC.X.ADI_AP2.digitnumber parameter determines how many digits to expect.

9 EL7 protocol

EL7 signaling

The EL7 TCP implements the application computer variant of the EL7 protocol found on an Ericsson MD110 PBX. The protocol can run on a PCM30 E1 trunk or on a T1 trunk in ESF mode. The protocol is not symmetric, and only the terminal (application computer) side of the protocol is supported.

The following table describes the signaling states of a typical inbound call originating from the PBX. ABCD signaling bits are shown:

State	Network	Direction	Terminal
Idle	1101	← →	1101
Seizure (internal)	0110	→	1101
Seizure (external)	0100	→	1101
Seizure (call back)	0111	→	1101
At this point an incoming call is presented to the application. The application can answer or reject it. If the application rejects the call, the inbound terminal does not respond to the ring signal. The calling party abandons the call with the signaling bits for the outbound side returning to the idle state.			
Idle	1101	→	1101
If the application answers the call, the line code changes to the call established state line code.			
Answer	01xx	←	0101
Answer acknowledge	0101	→	0101

The following table describes the signaling states of a typical outbound call originating from the terminal (application):

State	Network	Direction	Terminal
Idle	1101	← →	1101
Seizure	1101	←	0101
If the network cannot place the outbound call, it rejects it:			
Seizure rejected	0011	→	0101
If the network can place the outbound call:			
Seizure acknowledge	0101	→	0101
	Dial tone	→ ←	DTMF address digits
	Call progress tones	→	
The network may indicate a congestion/reorder or busy condition at this point:			
Congestion/reorder	0101 0100 0101	→	0101
Busy	0101 0111 0101	→	0101
Otherwise, the call proceeds. If the called party answers, an answer indication may be given:			
Answer	0101 0001 0101	→	0101
On an established call, the application may request a register recall in order to transfer a call:			
Call established	0101	← →	0101
Register recall	0101	←	0101 0001 0101
If the network can place the outbound call,			
Recall acknowledge	0101 0111 0101	→	0101
	Dial tone	→	
After which, the outdialing for the second call continues.			

The following table describes the disconnect of established calls, regardless of which side originated the call:

State	Network	Direction	Terminal
The application disconnects the established call first:			
Call established	0101	← →	0101
On hook	0101	←	1101
Return to idle	1101	→	1101
The network disconnects the established call first:			
Call established	0101	← →	0101
Disconnect clear	0101 1101 0101	→	0101
On hook	0101	←	1101
Return to idle	1101	→	1101

EL7 parameters

The following table describes NCC.X.ADI_EL7 parameters. Generally, these parameters are not altered from their default values.

Field	Unit	Default	Description
WaitForPC	ms	10000	Time protocol will wait for application before taking independent action.
WaitForSeizureAck	ms	5000	(0 = forever) waiting for network acknowledgment of the seizure (outbound).
WaitForAnswerAck	ms	2000	(0 = forever) waiting for network acknowledgment after answering call (inbound).
WaitBeforeOutOfService	ms	25000	(0 = forever) waiting for network idle before line is taken out of service.
QualifyOn	ms	12	Qualification of signaling detector changes (DSP).
PulseIn	ms	25	Qualification of received detector changes (TCP).
PulseOut	ms	60	Duration of transmitted signaling pulses.
WaitIdleAfterReject	ms	120	After rejecting inbound call, time before idle.
WaitForReconnectBack	ms	2000	Wait for recall after clearing second call.
WaitForRecallAck	ms	5000	Wait for recall register acknowledge.
ReleaseGuard	ms	650	Minimum idle time after call clearing.
NetworkSide	mask	0	Must be set to 0.
WaitForAnswerOffHook	ms	20000	Do not modify.
VariableDigits	ms	1	Do not modify.
NumberOfDigits	count	3	Do not modify.
WaitFirstDigit	ms	7000	Do not modify.
WaitNextDigit	ms	3000	Do not modify.

10 European digital CAS (EUC) protocol

EUC country-specific signaling

The EUC TCP implements the national CAS specifications of three European countries: Italy, Sweden, and the Netherlands. These countries define protocols that use two bits line signaling and DTMF digit spill register signaling, and are similar enough to be implemented by the same trunk control program.

Although E1 channel associated signaling (CAS) framing supports 4 signaling bits per direction, only 2 of them are used for the protocols implemented by the EUC TCP. Thus the signaling channels supporting the line signaling of these protocols are referred to as A_f and B_f in the forward direction, and A_b and B_b, in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment). The C and D bits never change. Their value is 0 and 1 respectively.

The following country-specific tables describe the line signaling for a typical call:

- EUC signaling for Italy (Norma CEI 103-1/7)
- EUC signaling for Sweden (P7/P8)
- EUC signaling for the Netherlands (ALS70D)

EUC signaling for Italy (Norma CEI 103-1\7)

The following table shows signaling states associated with the EUC TCP for Italy:

State	Outbound A_fB_f	Direction	Inbound A_bB_b
Idle	01	← →	01
Seizure	10	→	01
Seizure acknowledged	10	←	11
The outbound side starts to send the address information using DTMF tones or decadic pulses. If the method is decadic pulses, the A_f bit is switched off (pulse on) and on (pulse off) repeatedly to signal the digits.			
Register signaling: digit spill	DTMF	→	11
Register signaling: pulse dial	00 pulse on	→	11
	10 pulse off	→	11

State	Outbound A_fB_f	Direction	Inbound A_bB_b
All the address information has been transferred. Now the inbound side must accept or reject the call by sending a wink: a temporary change in the bit pattern. The bit pattern is AB=10 if the inbound accepts the call, AB=01 if it rejects the call.			
End of selection - free	10	←	11-10-11 (150 ms)
End of selection - busy	10	←	11-01-11 (150 ms)
If the call is accepted, the inbound side plays a ring tone on the line after resuming to signal AB = 11 (seizure acknowledged). If the call is rejected, the outbound side switches back to signaling AB = 01 (idle), clearing the line.			
Ringing	10	←	11
Answer - conversation state	10	←	00
The outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. In this case, the answer pattern (AB = 00) from inbound temporarily changes to AB = 10. Billing pulses are generated by the network, not by the inbound terminal.			
Billing pulses	10	←	00-10-00 (125 ms)
Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. A period of release guard from inbound follows both signals, meaning acknowledgment of the clear operation. Idle follows.			
Inbound hangs up first: Clear back	10	←	01
Clear forward	01	←	01
Release guard	01	→	11
Idle	01	← →	01
Outbound hangs up first: Clear forward	01	→	00
Release guard	01	←	11
Idle	01	← →	01

EUC signaling for Sweden (P7/P8)

P7/P8, the Swedish National CAS Protocol, is asymmetrical, meaning that the terminal equipment sends and receives different signals to perform call setup with respect to the near-end switch.

Two variations of incoming calls can be received: using the P7 or using the P8 protocol. The P7 protocol is two-way: it can be used both to place and to receive calls. The inbound (call reception) capability does not support the transfer of DID digit, but acts essentially as a subscriber's telephone on a E1 timeslot. The P8 protocol is inbound only, and supports DID transmission.

Three signaling tables are necessary to specify the protocol:

- Placing calls with P7
- Receiving calls with P7
- Receiving calls with P8

Placing calls with P7

The following table shows signaling states associated with placing calls with P7 when using the EUC TCP for Sweden:

State	Outbound A_fB_f (TCP)	Direction	Inbound A_bB_b (Network)
Idle	10	← →	10
Seizure	00	→	10
The inbound network side starts playing a dial tone on the voice channel, indicating that in-band (DTMF detectors) resources are available to receive the address information.			
Dial tone	00	←	10
Once it has detected the dial tone, the outbound side starts to send the address information using DTMF tones.			
Register signaling: digit spill	DTMF	→	10
If the call is accepted, the inbound side plays a ring tone on the line and then flips the A_b bit to signal 00. Otherwise, it plays busy on the line.			
Ringing	00	←	10
Answer - conversation state	00	←	00
The outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. In this case, the answer pattern (AB = 00) from inbound temporarily changes to AB = 01.			
Answer - conversation state	00	←	00
Billing pulses	00	←	01
Answer - conversation state	00	←	00
Depending on which side hangs up the call first, a clear forward signal or a clear back signal followed by a clear forward signal, is generated. Idle follows.			
Clear back	00	←	10
Clear forward	10	→	00 or 10
Idle	10	← →	10

Receiving calls with P7

The following table shows signaling states associated with receiving calls with P7 when using the EUC TCP for Sweden:

State	Outbound A_fB_f (Network)	Direction	Inbound A_bB_b (TCP)
Idle	10	← →	10
Seizure	01	→	10
Immediately when seized, the CPE (the TCP) plays a ring tone on the line if the connected telephone is on-hook; a busy tone if it is off-hook. If the tone is busy, the network abandons the call. When the connected telephone is picked up, the TCP flips the A-bit to signal answer. The network then flips its B_f bit to signal that the call is through-connected to the remote caller.			
Ringing	01	←	10
Answer	01	←	00
Through connection	00	→	00
Depending on which side hangs up the call first, a clear forward signal or a clear back signal followed by a clear forward signal, is generated. Idle follows.			
Clear back	00	←	10
Clear forward	10	→	00 or 10
Idle	10	← →	10
If there is a clear back (for example, if the CPE clears the call first and the network has a call waiting for that timeslot), the line can be seized immediately. In this case, the sequence restarts from the seizure (second row of this table).			
Clear back	00	←	10
Seizure	01	→	10

Receiving calls with P8

The following table shows signaling states associated with receiving calls with P8 when using the EUC TCP for Sweden:

State	Outbound A_fB_f (Network)	Direction	Inbound A_bB_b (TCP)
Idle	10	← →	10
Seizure	00	→	10
Proceed to send (seizure acknowledged)	00	←	00
Once it has detected the proceed to send signal, the outbound side starts to send the address information using DTMF tones.			
Register signaling: digit spill	DTMF	→	00
When all the digits have been received, the inbound side flips the A_b bit to signal that it has enough information. This state is maintained for at least 300 ms, and during ringing.			
Number received	00	←	10
If the call is accepted, the inbound side plays a ring tone on the line and then flips the A_b bit to signal AB = 00. Otherwise, it plays a busy tone and the network abandons the call.			
Ringing	00	←	10
Answer - conversation state	00	←	00
Depending on which side hangs up the call first, a clear forward signal or a clear back signal followed by a clear forward signal, is generated. Idle follows. If the network clears the call first, the CPE must stay in connected (AB=00) for at least 150 ms but less than 250 ms.			
Clear back	00	←	10
Clear forward	10	→	00 or 10
Idle	10	← →	10

EUC signaling for the Netherlands (ALS70D)

ALS70D, the Dutch National CAS protocol, is asymmetrical, meaning that the terminal equipment sends and receives different signals to perform call setup with respect to the near-end switch. Thus, two signaling tables are necessary to specify the protocol, one for the TCP placing calls (outbound), and one for the TCP receiving calls (inbound).

This topic describes how signaling is carried out by the:

- Outbound TCP
- Inbound TCP

Signaling carried out by the outbound TCP

The following table shows signaling states associated with the outbound TCP when using the EUC TCP for the Netherlands:

State	Outbound A_fB_f (TCP)	Direction	Inbound A_bB_b (Network)
Idle	10	← →	10
Seizure	00	→	10
The normal behavior after the outbound TCP signals seizure is the detection of a seizure acknowledged. However, call collision can occur, and the TCP can receive a seizure from the network as well. If the seizure from the network comes 200 ms from the original seizure, then the outbound TCP must send seizure acknowledged and receive a call. It then behaves as shown by the table, describing the inbound TCP behavior.			
Seizure acknowledged	00	←	11
The inbound network side starts playing a dial tone on the voice channel, meaning that in-band (DTMF detector) resources are available to receive the address information. Once it has detected the dial tone, the outbound side starts to send the address information using DTMF tones or pulse dial. If the method is pulse dial, the B_f bit is switched on (pulse on) and off (pulse off) repeatedly to signal each digit.			
Register signaling: digit spill	DTMF	→	11
Register signaling: pulse dial	01 pulse on	→	11
	00 pulse off	→	11
If the call is accepted, the inbound side plays a ring tone on the line and then flips the A_b bit to signal 01. Otherwise, it flips the B_b bit to signal 10 (idle).			
Ringing	00	←	11
Answer - conversation state	00	←	01
The outbound protocol can receive billing pulses to signal that a unit of cost was billed to the call. In this case, the answer pattern (AB = 01) from inbound temporarily changes to AB = 00.			
Answer - conversation state	00	←	01
Billing pulses	00	←	00
Answer - conversation state	00	←	01
Depending on which side hangs up the call first, a clear forward signal or a clear back signal is generated, followed by a clear forward. Idle follows.			
Clear back	00	←	11
Clear forward	10	→	01 (or 11)
Idle	10	← →	10

Signaling carried out by the inbound TCP

The following table shows signaling states associated with the inbound TCP when using the EUC TCP for the Netherlands:

State	Outbound A_fB_f (Network)	Direction	Inbound A_bB_b (TCP)
Idle	10	← →	10
Seizure	00	→	10
Seizure acknowledged	00	←	11
The seizure acknowledged line state for the inbound TCP lasts for a certain time period. This time period is set to 100 ms in the TCP. After that, a ready to receive bit transition is sent to signal the network that the TCP is ready to receive the address information. This signal means that the resource dedicated to detect DTMF tones has been allocated.			
Ready to receive	00	←	01
Once it detects the ready to receive signal, the outbound side starts to send the address information using DTMF tones or pulse dial. If the method is pulse dial, the B_f bit is switched on (pulse on) and off (pulse off) repeatedly to signal each digit.			
Register signaling: digit spill	DTMF	→	01
Register signaling: pulse dial	01 pulse on	→	01
	00 pulse off	→	01
When all the digits have been received, the inbound side flips the A_b bit to signal that it has enough information. This state is maintained for at least 300 ms.			
Number received	00	←	11
If the call is accepted, the inbound side plays a ring tone on the line and then flips the A_b bit to signal AB = 01. Otherwise, it plays busy and flips the B_b bit to signal AB = 10 (idle).			
Ringing	00	←	11
Answer - conversation state	00	←	01
Depending on which side hangs up the call first, a clear forward signal or a clear back signal is generated, followed by a clear forward. Idle follows.			
Clear back	00	←	11
Clear forward	10	→	01 (or 11)
Idle	10	← →	10

EUC register signaling

In general the protocols supported by the EUC TCPs use either in-band DTMF tones or out-of-band decadic pulses to transfer register signaling information.

The Italian and Dutch protocols only transfer DID (direct inward dialing - the called address) information. To do this the outbound side sends either a stream of DTMF tones or a sequence of decadic pulses to the inbound side, then considers the dialing done and waits for some confirmation from the inbound side. This register signaling technique, in which the outbound side has no acknowledgment from the inbound side until the dialing is finished, is called digit spill.

The Swedish P8 protocol (setting up calls from the network to a CPE) can transfer other kinds of information. An incoming call with P8 can convey the following:

- ANI digits (caller ID);
- The last redirecting number (if the call was redirected from another terminal); or
- Both of the above.

To do this, the protocol still uses a DTMF digit spill, but with special codes and separators that delimit the different fields.

The syntax is the following:

[A$c_1c_2c_3c_4c_5$Dt_1...t_n[Dt_1...t_n]C]d_1...d_n

Where:

- The A, C, and D characters must be taken literally (A=DTMF A)
- c_n is a DTMF tone used as a code element between the A and D digits
- t_n is a tone representing information about the call
- C represents the end of the call information part of the digit spill
- d_n is a DID digit.

A maximum of two D digits (separators) can be present, depending on the code that follows the A digit. If the first DTMF tone received is not A, only DID digits are present.

The following table describes the valid codes:

Code	Description
00000	Only ANI information is available (one Dt_1...t_n sequence)
00030	Only last forwarding number available (one Dt_1...t_n sequence)
00031	ANI and last forwarding number available (two Dt_1...t_n sequences, first ANI and second last redirecting number)

EUC editable parameters

To program the EUC TCP to implement the specifications of the supported countries and network operators, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_EUC. You can modify parameters that program TCP/host interaction, configure unregulated features or configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_EUC parameters (within the parameter category NCC.X.ADI_EUC) that you can modify:

Field	Type/ Unit	Default	Description
digitnumber	count	7	Inbound: specifies number of incoming digits to expect.
waitingplaybusy	mask	0x1	This parameter and the waitingplayreorder parameter specify what to play as cleardown tone (the tone the TCP plays when an inbound call is released and the calling party has not hung up yet). If this parameter is 1,the busy tone is used as the cleardown tone. If neither of the parameters is set, the TCP remains silent.
waitingplayreorder	mask	0x0	This parameter and the waitingplaybusy parameter specify what to play as cleardown tone. If this parameter is 1, the fast busy (reorder) tone is used as the cleardown tone. If neither of the parameters is set, the TCP remains silent.
trunkdirection	mask	0x0	Determine trunk direction: 0 - Bidirectional 1 - Inbound only (no calls can be placed on it) 2 - Outbound only (no calls can be received on it)
detectnetworkaudio	mask	0x0	Setting this parameter to 1 forces the TCP to perform call progress when all digits have been delivered to the network in an outbound call, even for protocols that give a positive indication of the state of the call. The default value is 0. This value will not start call progress detection if the user sets the connectmask to connect on SIGNAL. The 0 value saves DSP resources.
lastdtmf	mask	0x0	These bits define the ST tone: the last received tone that outbound sends. 0 = ignored

Refer to *EUC non-editable parameters* on page 92 for more information.

EUC non-editable parameters

The following NCC.X.ADI_EUC parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Unit	Default	Description
seizureacktime	ms	10000	Outbound: Specifies time to wait for seizure acknowledgment after seizing the line.
seizurewaittime	ms	200	Outbound: Specifies the time to wait to be seized on a two-way trunk, after the TCP seized the line.
answerwaittime	count	90	Outbound: Specifies the maximum time for the protocol to wait after the call accepted indication until the phone is answered (seconds).
acceptwaittime	ms	20000	Outbound: Specifies the maximum time for the protocol to wait after dialing before being notified that either the call has been accepted and the phone is ringing, or that the call has been rejected.
digitspilltime	ms	20000	Inbound: Specifies the total time the dialing process is allowed to take.
bitqualtime	ms	20	Specifies the qualification time for bit changes.
interdigitreceivetime	ms	20000	Inbound: While receiving decadic pulses, if the number of expected incoming digits is not known, this parameter specifies the time between two trains of pulses to conclude that the incoming dial string is finished.
winktime	ms	150	Inbound: Specifies the duration of an inbound wink. Depending on the target country, the wink has a different meaning and occurs at different phases of call setup.
toneontime	ms	80	Specifies the time a DTMF tone should be ON while dialing.
toneofftime	ms	80	Specifies the time a DTMF tone should be OFF while dialing.
pulseontime	ms	50	Specifies the time a pulse should be ON while dialing with decadic pulses.
pulseofftime	ms	50	Specifies the time a pulse should be OFF while dialing with decadic pulses.
hightoneamplitude	IDU	352	Specifies the amplitude of the higher frequency of the DTMF tones while dialing.
lowtoneamplitude	IDU	440	Specifies the amplitude of the lower frequency of the DTMF tones while dialing.
interdigitsendtime	ms	700	Outbound: Specifies the time between two trains of pulses while dialing with decadic pulses.
dialpulsemethod	mask	0	Determines the dialing type: 0 - DTMF dialing 1 - Decadic dialing

Field	Type/ Unit	Default	Description
errorearlyanswer	mask	0x0	If this parameter is set to 1, an answer signal before all digits have been dialed is an error, and the TCP clears the call.
signalswep7in	mask	0x0	Configures protocol for inbound P7.
NMScountry	count	25 (Italy)	NMS code for the target country.
mintimeconnected	ms	200	Inbound: The minimum time the TCP must remain in the connected state (in order to allow the switch to bill the call).
incomingqualtime	ms	60	Inbound: Signaling bits qualification time while playing ring tone (Italy only).
releaseguardtime	ms	250	Inbound: Minimum time the release guard signal must be on.
timewaitunblock	ms	200	Time the TCP waits after receiving the command to unblock the line, before actually doing it and going to idle.
timeinterdigit	ms	400	Inbound: Minimum time between trains of decadic pulses.
maxbillingpulse	time (ms)	200	Outbound: Maximum duration of billing pulse (for those protocols in which the line code of a billing pulse is the same as clear back).
maxdecadicpulse	time (ms)	100	Inbound: Maximum duration of decadic pulse (for those protocols in which the line code of a decadic pulse is the same as clear forward).

The following parameters are reserved for internal NMS use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *EUC editable parameters* on page 91 for more information.

EUC and NCC service call control

When applications perform NCC service call control with the EUC protocol, they can process digits in the following ways:

Method used to process digits	Description
Inbound calls: Receiving digits all at once	With EUC TCPs, after NCCEVN_INCOMING_CALL is received, the calledaddr field in the NCC_CALL_STATUS structure contains all received digits. The callingaddr, usercategory and tollcategory fields are NULL. The parameter NCC.X.ADI_EUC.digitnumber determines the number of digits the TCP should expect from the calling party. Default is 7.
Inbound calls: Receiving digits one at a time	Make sure the NCC.START.OVERLAPPED.RECEIVING parameter is set. The TCP does not recognize ANI or category digits. Digits are presented in the order in which they arrive. The NCC.X.ADI_EUC.digitnumber parameter determines how many digits to expect. In the case of the P8 Swedish protocol with ANI and redirecting terminal information, the digit string can be received as follows: # ***firstfield*** # [***secondfield***] # $d_1 \ldots d_n$ where ***firstfield*** and ***secondfield*** are contingent to the reception of the corresponding code. The code itself is not presented to the application.
Outbound calls: Formatting the digit string	EUC TCPs expect the digit string to be formatted as follows: $d_1 \ldots d_n$ ANI and category indicators are not used in EUC TCPs.

11 Feature group D (FGD) protocol

FGD signaling

The FGD TCP implements the specifications of the feature group D (FGD) switched access service. This service provides interconnection to the BOC (Bell operating companies) network for the provision of message telecommunications service/wide area telecommunications service (MTS/WATS) and MTS/WATS-type services. FGD service, which provides access to the trunk side of suitably equipped BOC switching systems, is available for termination and originating access.

If you used the FDI protocol in the past, you should now migrate to the new feature group D (FGD) protocol.

Feature group D signaling is derived from wink start signaling. Like wink start, FGD uses only two of the four bits per signaling direction supported by E1 channel associated signaling (CAS) framing. The signaling channels supporting the FGD line signaling protocol are referred to as A_f and B_f in the forward direction, and A_b and B_b, in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

The other bits in either direction (the C and D bits) usually have fixed values. However, their values may change from network to network.

The inbound side uses multiple winks to acknowledge reception of different series of incoming digits. The following table describes the line signaling for a typical call:

State	**Outbound A_fB_f**	**Direction**	**Inbound A_bB_b**
Idle	00	← →	00
Seizure	11	→	00
Seizure acknowledged	11	←	00-11-00 (wink)
The outbound side starts to send the address information using MF tones. Feature group D can transfer more than one digit field to speed up long distance calls. Every field starts with a KP tone (start of pulsing) and ends with an ST tone (end of pulsing). After each digits field the inbound side acknowledges the reception with a signaling bit wink.			
Register signaling first field: digit spill	MF tones	→	00
Acknowledgment of first series of digit		←	00-11-00 (wink)
Register signaling second field: digit spill	MF tones	→	00
Once all the address information has been transferred, the inbound side accepts the call by sending the off-hook signaling code or rejects the call by playing busy. If the call is rejected, the outbound side switches back to signaling AB = 00 (idle), clearing the line.			
Clear forward and idle	00	→	00
If the call is accepted, the inbound side answers the call by flipping both backward bits to 1.			
Answer - conversation state	11	←	11
Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. Idle follows.			
Inbound hangs up first: Clear back	11	←	00
Outbound hangs up first: Clear forward	00	→	00 or 11
Idle	00	← →	00

FGD editable parameters

To program the FGD TCP to implement the specifications of the supported countries and network operators, modify the TCP-specific parameters stored within the parameter category NCC.X.ADI_FGD. You can modify parameters that program TCP/host interaction, configure unregulated features or configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_FGD parameters (within the parameter category NCC.X.ADI_FGD) that you can modify:

Field	Unit	Default	Description
optionflags	mask	0x0	Not used
sendanididwink	mask	0x0	If set, generate wink between ANI and DID digits.
expectanididwink	mask	0x0	If set, expect wink between ANI and DID digits.
expectfinalwink	mask	0x1	Determines if there is a final wink after digit reception: 0 - There will be a final wink. 1 - There will not be a wink.

Refer to *FGD non-editable parameters* on page 97 for more information.

FGD non-editable parameters

The following NCC.X.ADI_FGD parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Unit	Default	Description

IDdigitmask	mask	0x28	Determines which digits identify the ID field when they are received. The first digit must be 1. The second digit is extracted from this parameter.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`1000|0000|0010|1000`

setupbitqualtime	ms	50	Bit signaling qualification time for on-hook to off-hook transitions.
permanentsignaltime	ms	60000	Maximum time for remote end to remain off hook when trunk is not in the conversation state before a permanent signal condition is detected. Valid range is 1-65535.
defaultrejecttone	integer	2	Default tone to play if the PC does not respond to an incoming call indication (see waitforPCtime): 0 - Ringing 1 - Busy 2 - Reorder (fast busy)
winktime	ms	200	For incoming calls, the duration of the generated wink. Set this to 0 for no wink. Set to 0xFFFF for 350+440 Hz dial tone to be generated.

Field	Unit	Default	Description
prewinktime	ms	100	Delay after incoming seizure is detected and before the start of the wink.
wait1stdigittime	ms	7000	Maximum time to wait for the first incoming digit after the completion of the wink.
waitfordigittime	ms	8000	Maximum time to wait for each incoming digit after the first one.
winkwaittime	ms	10000	Maximum time to wait for the far end to wink for an outgoing call. Set this to 0 if no wink is expected.
maxwinktime	ms	4900	Maximum duration of a detected wink.
predialtime	ms	70	Delay to start of outgoing address signaling after end of wink is detected.
mfkpsttimeon	ms	80	Duration of tone on for MF, KP, and ST.
mfkpsttimeoff	ms	80	Duration of tone off for MF, KP, and ST.
mfkpstampl	IDU	352	Amplitude of dialed tones.
releaseguardtime	ms	1000	Minimum on-hook internal between calls.
preanswertime	ms	100	Delay after the application has commanded to answer, and before the answered signal is sent to the network. The FGD TCP does not play a ring tone when accepting a call, but a certain delay is necessary.
noresourcemask	integer	0	Mask that controls behavior when no resource is granted on inbound calls. 0 - No signaling; just send error 1 - Generate wink, then send error
customSTtones1	mask	0x0	Send customized ST tones.
customSTtone2	mask	0x0	Send customized ST tones.
customSTtone3	mask	0x0	Send customized ST tones.
alarmsonqualtime	ms	5000	Determines the qualification time for trunk alarms (time to wait after the commencement of a trunk alarm before the TCP is notified).
alarmsoffqualtime	ms	4000	Determines the qualification time for trunk alarm end (time to wait after a trunk alarm state ended before the TCP is notified).

The following parameters are reserved for NMS internal use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *FGD editable parameters* on page 97 for more information.

FGD and NCC service call control

When an application performs natural call control with the FGD protocol, after the application receives an NCCEVN_INCOMING_CALL event, it can invoke **nccGetCallStatus** to retrieve the following information within the NCC_CALL_STATUS structure:

Field	Description
calledaddr	The called number. Also referred to as the direct inward dial (DID) number.
callingaddr	The calling number (if available). Also referred to as the automatic number identification (ANI) number.

The following field is in the NCC_CAS_EXT_CALL_STATUS structure:

Field	Description
carrierid	Carrier ID information (if available).

With FGD, all digits are MFs; no DTMF signaling is used. By default, a group of incoming digits begins with a KP tone, followed by digits, then an ST tone. This may be followed by a wink, then perhaps one or more other KP-digits-ST-wink sequences.

12 Ground start (GDS) protocol

GDS signaling

Ground start protocols exist in both analog and digital variations. The NMS ground start TCP covers digital interfaces. The protocol can handle T1 or E1 digital trunks, of signaling types FX (foreign exchange) or SA (special access). The trunk and signaling type is determined using the trunktype parameter.

If you were using GST8 or GST9 protocols, you should migrate to the digital ground start (GDS) protocol.

Although E1 channel associated signaling (CAS) framing supports four signaling bits per direction, only two of them are used for digital ground start line signaling. Thus the signaling channels supporting the digital ground start line signaling protocol are referred to as A_f and B_f in the forward direction, and A_b and B_b, in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

The other bits in either direction (the C and D bits) usually have fixed values. However, their values may change from network to network.

The following tables describe digital ground start signaling in the two cases of FX and SA. Two tables are necessary, because the protocol changes depending on the side that started the call.

This topic provides information about GDS signaling in the following cases:

- The switch presents the call to the terminal equipment
- The terminal equipment places the call

Switch presenting calls to terminal equipment

The following table describes the case in which the switch presents calls to the terminal equipment:

State	Outbound switch A_fB_f	Direction	Inbound terminal A_bB_b
Idle	11 (FX) 01 (SA)	← →	01 (FX) 00 (SA)
Seizure	01 (FX) 11 (SA)	→	01 (FX) 00 (SA)
At this point, the incoming call is presented to the application. The application can answer or reject it. If the application answers it, after the specified number of rings the connected code is put on the line.			
Ring on	00 (FX) 10 (SA)	→	01 (FX) 00 (SA)
Ring off	01 (FX) 11 (SA)	→	01 (FX) 00 (SA)
Answer - conversation state	01 (FX) 11 (SA)	←	11 (FX) 10 (SA)
If the inbound side application rejects the call instead, the TCP does not pick up the phone, and eventually the calling party abandons the call.			
In conversation state, if the switch side clears the call, a cleardown tone might be on the line. The terminal responds to this by hanging up the call.			
Inbound disconnects first	01 (FX) 11 (SA)	←	01 (FX) 00 (SA)
Outbound disconnects	11 (FX) 01 (SA)	→	11 or 01 (FX) 10 or 00 (SA)
Idle	11 (FX) 01 (SA)	← →	01 (FX) 00 (SA)

Terminal equipment placing calls

The following table describes the case in which the terminal equipment places calls:

State	Outbound terminal A_fB_f	Direction	Inbound switch A_bB_b
Idle	01 (FX) 00 (SA)	← →	11 (FX) 01 (SA)
Seizure	00 (FX) 01 (SA)	→	11 (FX) 01 (SA)
Seizure acknowledged	00 (FX) 01 (SA)	←	01 (FX) 11 (SA)
Off hook	11 (FX) 10 (SA)	→	01 (FX) 11 (SA)
Proceed to send	11 (FX) 10 (SA)	← dial tone	01 (FX) 11 (SA)
Here the outbound side starts to send the address information. This can be done by means of DTMF tones, or by decadic pulses. If the method is decadic pulses, the A-bit is switched off (pulse on) and on (pulse off) repeatedly to signal the digits. If the call is accepted, the network (or the PBX) plays ring on the line; otherwise it plays an appropriate call progress tone.			
Answer - conversation state	11 (FX) 10 (SA)	← voice	01 (FX) 11 (SA)
Inbound disconnects first	11 (FX) 10 (SA)	←	11 (FX) 01 (SA)
Outbound disconnects	01 (FX) 00 (SA)	→	11 or 01 (FX) 01 or 11 (SA)
Idle	01 (FX) 00 (SA)	← →	11 (FX) 01 (SA)

GDS editable parameters

To program the digital ground start TCP to operate within different countries and networks, modify the TCP-specific parameters stored within the parameter category NCC.X.ADI_GDS. You can modify parameters that program TCP/host interaction, that configure unregulated features or that configure features that can change from switch to switch within the same network.

The following table describes GDS parameters (within the parameter category NCC.X.ADI_GDS) that you can modify:

Field	Type/ Units	Default	Description
nodialtonebehavior	mask	0x0	Determines what to do if no dialtone is detected: 0 - The TCP hangs up and abandons the call. 1 - The TCP proceeds to dial anyway.
transfersupport	mask	0x0	Selects whether PBX transfer is allowed: 0 - Transfer commands are disabled. 1 - Transfer commands are allowed.
CIDsupport	mask	0x0	Indicates if caller ID is supported: 0 - CID disabled. 1 - CID enabled.
cleardowntone	mask	0x0	If network side, tone to play as dial tone (if 0, do not play cleardown tone): 1 - Play dial tone as cleardown tone. 2 - Play busy tone as cleardown tone. 3 - Play reorder (fast busy) as cleardown tone.
hangupsignal	mask	0x0	Flags that control the bit that signals hang up supervision. Cleardown tone is always detected. Bit 0 (&0x1): Hang up supervision on the A bit (default). Bit 1 (&0x2): Hang up supervision on the B bit.
trunktype	mask	0x0	Determines the trunk type: 0 - T1 1 - E1
signalingtype	mask	0x0	Determines the signaling type: 0 - Foreign Exchange (FX) 1 - Special Access (SA)

Refer to *GDS non-editable parameters* on page 105 for more information.

GDS non-editable parameters

The following NCC.X.ADI_GDS parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Units	Default	Description
bitqualtime	ms	10	Qualification time for bit detector.
minringontime	ms	100	Minimum duration of incoming ring.
maxringontime	ms	3000	Maximum duration of incoming ring.
maxringofftime	ms	8000	Maximum duration of silence between rings.
ringstoincoming	count	0	Number of rings to detect for an incoming call: 0 - 1st ring begin 1 - 1st ring end ***n*** - After ***n*** rings If caller ID is enabled (optionflags bit 3 = 1), the incoming call is reported after at least one ring.
dialtonewaittime	ms	5000	For outgoing calls, the maximum time to wait for initial dial tone.
dialtonemintime	ms	1000	For outgoing calls, the minimum duration of non-precise dial tone required before dialing will begin. Set this to 0 to disable non-precise dial tone detection. Precise dial tone detection is controlled by NCC.START parameters.
releaseguardtime	ms	1000	Minimum time between hang up and off hook.
CIDtype	integer	0	Type of caller ID protocol, if CID is enabled. 0 - BellCore CID protocol 1 - NTT Japan CID protocol 2 - ETSI CID protocol (V.23)
CIDmaxwaittime	ms	0	Maximum time to wait for caller ID to arrive before concluding the caller has hung up (if CID is enabled).
CIDmaxalerttime	ms	0	Maximum duration of an alert signal in caller ID protocol (if CID is enabled).
CIDminmarktime	ms	100	Minimum duration of the mark signal of the caller ID protocol that is interpreted as such.
xferstring	string[6]	!;	Prefix dial string for call transfer. The string is dialed before dialing the number, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing

Field	Type/ Units	Default	Description
connstring	string[6]	!	String for transfer back to the connected state with the first call. It is dialed if a call transfer fails, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
connectbacktime	ms	0x0	Time to wait after sending transfer back hookflash is the PBX was playing busy.
waitdialnodialtone	ms	500	Time to wait to dial if no dialtone detection is required.
ringsignalontime	ms	1000	Nominal ring-on time for network emulation.
ringsignalofftime	ms	3000	Nominal ring-off time for network emulation.

The following parameters are reserved for internal NMS use:

- numdigits
- alarmsonqualtime
- alarmsonqualtime

Refer to *GDS editable parameters* on page 104 for more information.

13 Mercury exchange line (MELCAS) protocol

MELCAS signaling

The MEL TCP implements the Mercury exchange line (MEL) channel associated signaling (CAS) protocol. The protocol can be run on a PCM30 E1 trunk, or on a T1 trunk in ESF mode.

The following table describes the signaling states of a typical inbound call originating from the PBX. ABCD signaling bits are shown:

State	Network	Direction	Terminal
Idle	1101	← →	1101
Ring on	1011	→	1101
Ring off	1001	→	1101
	Optional FSK caller ID	→	
At this point an incoming call is presented to the application. The application can answer or reject it. If the application rejects the call, the inbound terminal does not respond to the ring signal. The calling party abandons the call with the signaling bits for the outbound side returning to the idle state.			
Idle	1101	→	1101
If the application answers the call, the line code changes to the call established state line code.			
Answer	1001	←	0101
Call established	0101	→	0101

The following table describes the signaling states of a typical outbound call originating from the terminal (application):

State	Network	Direction	Terminal
Idle	1101	← →	1101
Seizure	1101	←	0101
	Dial tone	→ ←	DTMF address digits
	Call progress tone	→	
Answer	0101	→	0101

The following table describes the disconnect of established calls, regardless of which side originated the call.

State	Network	Direction	Terminal
The application disconnects the established call first:			
Call established	0101	← →	0101
Clear back	0101	←	1101
Disconnect clear	0001 1101	→ →	1101
Idle	1101	← →	1101
The network disconnects the established call first:			
Call established	0101	→ ←	0101
Disconnect clear	0001 1101	→ →	0101
Clear back	1101	←	1101
Idle	1101	→ ←	1101
Out of service blocking is also supported.			
Network blocked	1111	→	1101
Terminal blocked	1101	←	1111

MELCAS parameters

The following table describes NCC.X.ADI_MEL parameters. Generally, these parameters are not altered from their default values.

Field	Unit	Default	Description
nodialtonebehavior	mask	0	Behavior if no dialtone: 0 - abandon 1 - proceed
transfersupport	mask	1	1 - support transfer commands
CIDsupport	mask	0	1 - enable FSK caller ID
cleardowntone	mask	1	Choice of cleardown tones to play: 0 - do not play cleardown tone 1 - play dialtone 2 - play busy tone 3 - play fast busy tone
networkside	mask	0	Must be set to 0.
bitqualtime	ms	12	Qualification time for bit detector.
minringontime	ms	100	Minimum duration of incoming ring.
maxringontime	ms	3000	Maximum duration of incoming ring.
maxringofftime	ms	8000	Maximum duration of inter-ring silence
ringstoincoming	count	1	Number of rings for an incoming call: 0 - 1st ring begin 1 - 1st ring end n - after n rings
dialtonewaittime	ms	5000	For outgoing calls, the maximum time to wait for initial dialtone.
dialtonemintime	ms	1000	For outgoing calls, the minimum duration of non-precise dial tone required before dialing begins. Set this to 0 to disable non-precise dial tone detection.
xferstring	string	!;	Prefix dial string for call transfer. Meaning: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
connstring	string	!	String for transfer back to the connected state with the first call. It is dialed if a call transfer fails. Meaning: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing

Field	Unit	Default	Description
connectbacktime	ms	100	Time to wait after sending transfer back hookflash if the PBX was playing busy.
waitdialnodialtone	ms	500	Time to wait to dial if no dialtone detection is required.
waitforrelease	ms	10000	Time waiting for the remote end to disconnect.
waitfordisconnectclear	ms	1000	Time waiting for the remote end to send DisconnectClear signal after receiving a clear signal.
TmCIDmaxWait	ms	3000	Maximum time to wait for CID to arrive.
TmMinmark	ms	100	The CID minimum mark time.
disconnectClearDuration	ms	480	Duration of disconnect clear signal.
delayBeforeDiscClear	ms	200	Delay before sending disconnect clear.
releaseguard	ms	1000	Release guard time.

14 MF Socotel (MFS) protocol

MFS signaling

The MFS TCP implements the Spanish National CAS protocol, as specified by the Royal Decree 1562/1992, and amended by the Order 5309 of the Ministry of Industry, February 23, 1998.

Although E1 channel associated signaling (CAS) framing supports four signaling bits per direction, only one of them is used (in general) for MFS line signaling.

The signaling channels supporting the MFS line signaling protocol are referred to as A_f in the forward direction and A_b in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

The B_b bit might also be used, but only to convey billing pulses to the outbound equipment. The B_f bit is never used, and is always set to 1. The C and D bits are set to 0 and 1 respectively for both directions.

The following table describes the signaling states of a typical call:

State	Outbound A_fB_f	Direction	Inbound A_bB_b
Idle	11	← →	11
Seizure	01	→	11
Seizure acknowledged	01	←	01
The inbound side requests the address information, and the outbound side sends the data. This is accomplished by an in-band compelled sequence. The inbound side completes the compelled sequence by accepting or rejecting the call, using the last backward compelled tone. If the call is accepted, the inbound side plays a ring tone on the line, and then signals that the call was answered by setting the A_b bit to 0.			
Ringing	01	←	01
Answer - conversation state	01	←	11
If the inbound side rejects the call, the outbound side clears forward by setting the A_f bit to 1. The inbound side goes back to idle by setting the A_b bit to 1.			
Clear forward	11	→	01
Idle	11	←	11
During conversation, the outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. The bit used to carry a billing pulse is the B_b bit.			
Answer - conversation state	01	←	11
Billing pulses	01	←	10
Answer - conversation state	01	←	11
Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. There is then a period of time in which the inbound side holds a release guard state, which is the same as clear back but happens when the outbound side is already in the idle state. Idle follows.			
Inbound hangs up first: Clear back	01	←	01
Clear forward / release guard	11	→	01
Idle	11	←	11
Outbound hangs up first: Clear forward	11	→	11
Release guard	11	←	01
Idle	11	← →	11

Register signaling is accomplished by a MF Socotel compelled scheme that is different from the R2 (CCITT Recommendation 441) compelled sequence. The basic concepts are summarized as follows:

- At the beginning of the compelled sequence, the inbound equipment plays a request tone (usually send all digits). This is an MF tone. The outbound responds with a pure tone (1900 Hz), which acknowledges the request form inbound.
- Then the sequence switches sides. The outbound equipment plays MF tones (the address of the called terminal), while the inbound equipment plays acknowledgment tones.
- When all the digits are delivered, the sequence switches side again, and the inbound equipment accepts or rejects the call, depending on the state of the called terminal.

The compelled sequence can only work if a very strict numbering scheme is in use in the network. The inbound side must know exactly the number of DID and ANI digits to expect in order to allow the compelled sequence to take place correctly. In Spain all telephone numbers are nine digits long. All extensions reachable through the national CAS protocol are five digits long.

- The expected number of DID digits is always five.
- The number of DID digits while dialing out is always nine.
- The expected number of ANI digits is always nine.

MFS editable parameters

To program the MFS TCP to operate within different countries and networks, modify the TCP-specific parameters. These parameters are stored within the parameter category NCC.X.ADI_MFS. You can modify parameters that program TCP/host interaction, that configure unregulated features or configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_MFS parameters (within the parameter category NCC.X.ADI_MFS) that you can modify:

Field	Type/ Unit	Default	Description
DIDnumber	count	5	Inbound: Specifies the number of incoming DID digits to expect. In Spain, the PSTN always provides five DID digits.
ANInumber	count	9	Inbound: Specifies the number of incoming ANI digits to expect. Set to 0 for no ANI collection. Possible values are 0 or 9.
RTCdigitnumber	count	9	Outbound: Specifies the number of digits that must be provided to the network (RTC=Rede Telefonica Conmutada). Spain has a fixed 9 digit scheme which cannot be changed.
playbusyonreject	mask	0x1	Controls playing busy tone after rejecting a call: 0 - Do not play the tone. 1 - Play the tone (default).
playcleardowntone	mask	0x0	Controls playing cleardown tone after clearing back a call: 0 - Do not play the tone. 1 - Play the tone.
trunkdirection	mask	0x0	Determine trunk direction: 0 - Bidirectional 1 - Inbound only (no calls can be placed on it) 2 - Outbound only (no calls can be received on it)
anifirst	mask	0x0	If set to 1, inbound collects ANI digits first, then DID digits.
twooffivesignaling	mask	0x0	Set to 1 if using two-of-five signaling.

Refer to *MFS non-editable parameters* on page 115 for more information.

MFS non-editable parameters

The following NCC.X.ADI_MFS parameters are country or network specific, and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Unit	Default	Description
Compelled timers			
timerT1	ms	10000	Specifies Timer T1, maximum time between the line seized and the first request from inbound.
timerT2	ms	20000	Specifies Timer T2, maximum time between the end of a confirmation tone and the beginning of the next information tone.
timerT3	ms	5000	Specifies Timer T3, maximum time of a whole compelled cycle, starting when a information tone is started and ending when the corresponding confirmation tone stops (from the point of view of the party sending the information).
timerT4	ms	5000	Specifies Timer T4, maximum time of a whole compelled cycle, starting when a information tone starts and ending when the corresponding confirmation is stopped (from the point of view of the party sending the confirmation).
timerT5	ms	90	Specifies Timer T5, overall maximum duration of the compelled sequence.
timerT6	ms	30	Specifies Timer T6, minimum time between end of transmission of a confirmation signal and beginning of transmission of the next information tone.
Line signaling timers			
bitsqualtime	ms	20	Qualification time for bits signals.
releaseguardtime	ms	150	Minimum time of the release guard pulse (from inbound).
clearbacktime1	ms	100	Release guard recognition time if inbound clears first.
clearbacktime2	ms	200	Release guard recognition time if outbound clears first.
answertime	count	60	Time in seconds the outbound waits for the inbound to answer, after the end of register signaling if the call has been accepted.
Compelled tones Tones sent by the PSTN in Group A:			
tnGAPSTNsendallDID	mask	0xD	Send all DID digits (D).
tnGAPSTNsendallANI	mask	0xC	Send all ANI digits (C).
tnGAPSTNswitchtoG2	mask	0x8	Switch to Group II (8).
tnGAPSTNsendCallCategory	mask	0x38CD	Send the call category (3).

Field	Unit	Default	Description
Tones sent to signify various error conditions:			
tnCongestionGroupA	mask	0xA	Congestion in Group A (A).
tnANInotavailable	mask	0xF	ANI not available (F).
tnCongestionGroupB	mask	0x2	Congestion in Group B (2).
Backward Group B tones (in either direction):			
tnGBlinefree	mask	0x1	Line free, billing (1).
tnGBlinebusy	mask	0x4	Line busy (4).
tnGBunallocatednumber	mask	0x8	Unallocated number (8).
tnGBendofselection	mask	0x9	End of selection - line status unknown - call progress tone follows (9).
Backward Group A tones from the CPE:			
tnGACPEsenddigitGBC	mask	0x9	Send Digit Group BC (4).
tnGACPEsendallANI	mask	0x4	Send all ANI digits (2).
tnGACPEswitchtoGII	mask	0x2	Switchover to Group B (8).
tndefaultoutcategory	mask	0x8	Default outbound category (2): external call, billing by line.
compelledtonelevel	IDU	330	Amplitude of compelled tones.
congestiontones	count	3	Tones in the fast busy cycle.
congestionofftime2	ms	600	Duration of the interval between congestion tones.
alarmsonqualtime	ms	500	Qualification time for trunk alarms (time to wait after the commencement of a trunk alarm before the TCP is notified).
alarmsoffqualtime	ms	400	Qualification time for trunk alarm end (time to wait after a trunk alarm state ended before the TCP is notified).

Refer to *MFS editable parameters* on page 114 for more information.

MFS and NCC service call control

When applications receive calls using NCC service call control with the MFS protocol, they can receive digits in the following ways:

- All at once
- One at a time

Receiving digits all at once

For MFS, after NCCEVN_INCOMING_CALL is received, the following fields in the NCC_CALL_STATUS structure contain the received digits:

Field	Description
calledaddr	Called number. Also referred to as the direct inward dial (DID) number.
callingaddr	Calling number (if available). Also referred to as the automatic number identification (ANI) number.

The following field is in the NCC_CAS_EXT_CALL_STATUS structure:

Field	Description
usercategory	Call category.

Several entries in the TCP parameter file affect the way the MFS TCP accepts and processes digits.

MFS parameter	Description
NCC.X.ADI_MFS.DIDnumber	Number of direct inward dial (DID) digits the TCP should expect from the calling party. Default is 5.
NCC.X.ADI_MFS.ANInumber	Number of automatic number identification (ANI) digits the TCP should expect. Default for the Spanish National Numbering Plan is 9. This value should not be changed, unless it is set to zero; in this case no ANI digits are collected.
NCC.X.ADI_MFS.anifirst	Indicates if the inbound part of the MFS TCP requests the ANI digits or the DID digits first. Signaling-wise, there is no difference between the two options, both being equally supported by the specifications.

Refer to *Configuring TCPs* on page 23 for information about loading parameter files.

Receiving digits one at a time

For MFS, the digits appear in the following format:

$\boldsymbol{d}_1 \ldots \boldsymbol{d}_5$ # $\boldsymbol{a}_1 \ldots \boldsymbol{a}_9$ if receiving DID digits first.

$\boldsymbol{a}_1 \ldots \boldsymbol{a}_9$ # $\boldsymbol{d}_1 \ldots \boldsymbol{d}_5$ if receiving ANI digits first.

$\boldsymbol{d}_1 \ldots \boldsymbol{d}_5$ if not receiving ANI digits.

where:

Value	Description
$\boldsymbol{d}_1 \ldots \boldsymbol{d}_5$	DID digits received (always 5 in Spain for a CPE).
$\boldsymbol{a}_1 \ldots \boldsymbol{a}_9$	ANI digits received.
#	NMS separator symbol.

15 Multi-frequency R2 (MFC-R2) protocol

MFC-R2 signaling

The MFC-R2 protocol is defined by the CCITT (now ITU) Recommendations Q.421-Q.442, (CCITT Blue Book Volume VI, Fascicle VI.4, Geneva 1989). Many country-specific variations exist. The MFC0 TCP is programmed by the parameters described in the following tables to implement the specifications of all supported countries and network operators.

Although E1 channel associated signaling (CAS) framing supports 4 signaling bits per direction, only 2 of them are used for R2 line signaling. Thus the signaling channels supporting the R2 line signaling protocol are referred to as A_f and B_f in the forward direction, and A_b and B_b, in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

The other bits in either direction (the C and D bits) usually have fixed values. However, their values may change from network to network.

This topic describes:

- Signaling states
- Register signaling

Signaling states

The following table describes the signaling states of a typical call:

State	Outbound A_fB_f	Direction	Inbound A_bB_b
Idle	10	⟵ ⟶	10
Seizure	00	⟶	10
Seizure acknowledged	00	⟵	11
The outbound side starts to send the address information using in-band compelled MF tones. The inbound side completes the compelled sequence by accepting or rejecting the call, using the last backward compelled tone. If the call is accepted, the inbound side plays a ring tone on the line, and then signals that the call was answered by setting the A_b bit to 0.			
Ringing	00	⟵	11
Answer - conversation state	00	⟵	01
If the inbound side rejects the call, the outbound side clears forward by setting the A_f bit to 1. The inbound side goes back to idle by setting the B_b bit to 0.			
Clear forward	10	⟶	11
Idle	10	⟵	10
During conversation, the outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. The bit used to carry a billing pulse depends on national specifications.			
Answer - conversation state	00	⟵	01
Billing pulses	00	⟵	11 or 00
Answer - conversation state	00	⟵	01
Depending on which side hangs up the call first, a clear back signal or a clear forward signal, is generated. Depending on national specifications, there might be a period of time in which the inbound side holds a release guard state, which is the same as clear back but happens when the outbound side is already in the idle state. Idle follows.			
Inbound hangs up first: Clear back	00	⟵	11
Clear forward	10	⟶	11
Idle	10	⟵ ⟶	10
Outbound hangs up first: Clear forward	10	⟶	01
Release guard	10	⟵	11
Idle	10	⟵ ⟶	10

Register signaling

The MFC-R2 protocol uses a multi-frequency compelled scheme to perform register signaling (to exchange address information).

The outbound exchange starts by putting on the line a forward tone that represents the first digit of the called address. The inbound exchange detects the tone and answers with a backward tone, which acknowledges the previous forward tone and requests another digit. The inbound exchange can use different tones in the backward direction, each carrying a request for a different piece of information. The outbound exchange interprets the request and sends the appropriate digit.

When the outbound exchange detects the backward tone, it stops the current forward tone. When the inbound exchange detects the end of the forward tone, it stops its backward tone. When the outbound exchange detects the end of the backward tone, it starts the next tone, representing the next digit, and the cycle starts again.

Different kinds of information are transferred from the outbound to the inbound exchange in this way. The MFC-R2 protocol supports:

- DID digits (called party address)
- ANI digit (calling party address)
- Caller category (for instance, normal subscriber, pay phone, operator)
- Caller toll category (in some countries)
- The information if the call is to be billed or free

The NMS MFC-R2 protocol implementation gives developers control over all of these features.

MFC-R2 editable parameters

To program the MFC-R2 TCP to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_MFC. You can modify parameters that program TCP/host interaction, that configure unregulated features or features that can change from switch to switch within the same network. You can freely edit these parameters to suit your implementation.

The following table describes the NCC.X.ADI_MFC parameters that you can modify:

Field	Type/ Unit	Default	Description
DIDnumber	count	7	Inbound: Number of DID digits to expect.
ANInumber	count	8	Inbound: Number of ANI digits to expect.
DIDBeforeANI	count	1	Inbound: Number of DID digits to receive before asking for category.
nobusyonReject	mask	0x0	Determines if the TCP plays busy when rejecting a call. If not, the switch does it instead. 1 - Do not play. 0 - Play (default).
trunkdirection	mask	0x0	Determines trunk direction: 0 - Bidirectional. 1 - Inbound only (no calls can be placed on it). 2 - Outbound only (no calls can be received on it).
cleardowntone	mask	0x0	Determines if a cleardown tone (busy tone) is necessary when the inbound side of the TCP hangs up a call first: 0 - No cleardown tone is played. 1 - Play cleardown tone.
norejtoneUserAudio	mask	0x0	Plays a message while rejecting a call. If set to 1, the TCP sends the backward Group B tone to the network to accept the call, thus causing the network to establish the voice path. The TCP then waits for the far end to hang up while the application plays a message.
detectnetworkAudio	mask	0x0	If this parameter is set to 1, the TCP starts call progress in any case after an outbound call is accepted by the network, so that a message or SIT tone can be detected. Call progress detection by default is not started if the user sets the connectmask to connect on SIGNAL. This value saves DSP resources.
answerGroupA	mask	0x0	If this parameter is set to 1, the TCP answers an incoming call from Group A without asking the network for the caller's category (Group II forward tone). The caller's category will therefore be missing from the incoming call-related information delivered to the host.

Refer to *MFC-R2 non-editable parameters* on page 123 for more information.

MFC-R2 non-editable parameters

The following NCC.X.ADI_MFC parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Unit	Default	Description
Compelled timers			
compelledT1	ms	15000	T1: forward tones max on-time.
compelledT2	ms	27000	T2: forward tones max off-time.
compelledT3	ms	15000	T3: inbound compelled cycle timer.
releaseguardtime	ms	0	Inbound: time to wait in release guard, if set (regulated time for the inbound protocol to remain in blocking state after mutual hang-up).
Inbound line qualification timers (time for the inbound protocol to wait to recognize a line signaling change), expressed in units of 10 ms:			
inqualidletime	ms	20	Qualification time during idle.
inqualcompeltime	ms	100	Qualification time during the compelled sequence.
inqualconnectedtime	ms	100	Qualification time during connected.
Outbound line qualification timers (time for the inbound protocol to wait to recognize a line signaling change), expressed in units of 10 ms:			
outqualidletime	ms	20	Qualification time during idle.
outqualcompeltime	ms	20	Qualification time during the compelled sequence.
outqualconnectedtime	ms	20	Qualification time during connected.
seizureacktime	ms	240	Outbound: Time to wait for seizure acknowledge after seizure, before clearing forward. The CCITT Blue Book value is 200 ms, but the TCP must account for internal transmission time.
answertime	mask	60	Maximum time for the protocol to wait between receipt of the Group B backward tone and when the phone is answered (line signaling event). After this timer expires, the TCP clears the line.
inboundreleasetime	ms	430	Outbound: The time after which a clearback seen by outbound is treated as a remote hang up signal. If the signal lasts less than this value, it could be a billing pulse (only applicable during conversation).
GroupIIT1Timer	mask	15	Maximum time for the protocol to wait between the generation of the Group II forward tone and the detection of the Group B backward tone. This time usually is the same as timer T1 from the parameter compelledtimers, but it can be different in some countries.

Field	Type/ Unit	Default	Description
The following parameters contain the specification of all the tones needed by the protocols to implement the country-specific variation of R2. Each parameter holds more than one tone. Each tone uses 4 bits (one hexade) of the 16 bit word. Hexades are listed from least to most significant inside each parameter. **Backward Group A tones**. The TCP uses these tones to send requests to the calling party during the compelled sequence:			
tnGAsendnextDID	mask	0x1	Send next DID (A-1).
tnGAsendCAT	mask	0x5	Send Group I category (A-5).
tnGAsendnextANI	mask	0x5	Send next ANI (A-5).
tnGAswitchtoGB	mask	0x3	Send Group II tone (and switch to group B tone reception) (A-3).
Some backward Group B tones. The TCP uses these tones to send the final indication of the compelled sequence to the calling party:			
tnGBcongestion	mask	0x4	Indicate congestion (B-4). This is also applicable during Group A transmission.
tnGBunallocnumber	mask	0x5	Indicate unallocated number (B-5).
tnGBlinebusy	mask	0x3	Indicate busy (B-3).
tnGBlineoutoforder	mask	0x8	Indicate line out of order (B-8).
Forward tones indicating the end of or the non-availability of a certain type of information:			
tnDIDeoi	mask	0xF	End of DID digits. (I-15) Note that in some countries this tone doesn't exist. In this case the parameter is 0.
tnNoCategory	mask	0xC	Caller's category not available. In some countries the category must be available to the caller, so the parameter will be 0.
tnANIeoi	mask	0xF	End of ANI digits (I-15) - caller id available.
tnANIeoirestrictCID	mask	0x0	End of ANI digits - called id restricted. In most countries there is no distinction for MFC-R2 between restricted and non-restricted caller id. In this case the parameter is 0.
Backward tones indicating acceptance of the call:			
tnanswerGBtoll	mask	0x6	Call accepted in Group B - charge (B-6).
tnanswerGBfree	mask	0x7	Call accepted in Group B - free call (B-7).
tnanswerGA	mask	0x6	Call accepted in Group A (A-6).
tnaltGB	mask	0x06	Alternative tone for call accepted in Group B (not in CCITT specifications, but necessary in some countries, such as CZH).

Field	Type/ Unit	Default	Description
Request or indication tones used in different contexts by the TCP:			
tnoutGIIcategory	mask	0x1	Tone the outbound part of the TCP plays in Group II (toll category in some countries) (II-1, normal subscriber).
tnGIcategory	mask	0x1	Default user category (Group I category) to be used if the application does not provide it (in some countries the outbound must play it in all cases) (I-1, normal subscriber).
tnGIANInotavailable	mask	0xC	Tone meaning that after the user category no ANIs are available (I-12, or 0xC).
tnGBmessagefollows	mask	0x0	Backward Group B tone used in some countries to reject an incoming call while requesting that the voice path be open for a special announcement.
Request or indication tones used in different contexts by the TCP:			
tnRepeatLastMinus1DID	mask	0x2	Repeat digit ***n***-1 (A-2), where ***n*** is the DID digit that the outbound side last played.
tnRepeatLastMinus2DID	mask	0x7	Repeat digit ***n***-2 (A-7).
tnRepeatLastMinus3DID	mask	0x8	Repeat digit ***n***-3 (A-8).
tnRepeatAllDID	mask	0x0	Repeat all digits (restart dialing). Not specified by the CCITT Blue Book, but used in many countries.
Backward tones that the inbound plays when it is collecting ANIs (the specifications of some countries identify a Group C in this case):			
tnSendNextDIDfromANI	mask	0x1	Request the outbound to go back to sending DIDs, and send the next DID. This is typically the same as the normal send DID tone, hexade 1 of tonesgroupA, but it can be different in some countries, such as Mexico.
tnRepeatLastDID	mask	0x0	Request the outbound to go back to sending DIDs, and repeat the last DID transmitted. Not supported by the CCITT Blue Book (C-6).
tnSpecifyCircuit	mask	0x0	Tone that inbound sends to request that outbound specify the nature of the circuit, either land-based or through a satellite link (A-13).
tnCheckEchoSuppress	mask	0xE	Tone that inbound sends to ask if a half-echo suppressor is needed (A-14).
Miscellaneous parameters			
compelledtonelevel	IDU	330	R2 tones amplitude (forward and backward)
bmCDbit	mask	0x1	Value of the C and D bits (usually, C=0, D=1).

Field	Type/ Unit	Default	Description
bmnodigitbehavior	mask	0x0	What to do if next DID does not come: 0 - Pulse congestion 1 - Pulse request for Group II tone This addresses the problem of those protocol variations that do not have a tone to signal the end of DID digits. In this case, the bit is set to 1, so the compelled sequence continues with the request to send the Group II tone and switch to reception of Group B tones.
bmringfaults	mask	0x0	What to do if bit faults are detected during ring: 0 - Ignore bit faults, or 1 - Detect and abort the call.
postdialdelay	mask	0x2	Controls the length of delay after outbound hangs up before the application is able to place a new call. This is needed by some switches to clear the line and be able to be seized again. Values: 0x0 - No delay 0x1 - 400 ms delay 0x2 - 700 ms delay (default) 0x3 - 1000 ms delay
bmhangupbyreleaseguard	mask	0x0	Flag to determine if an inbound clearing back is signaled by: 0 - A forced release (AB=00) 1 - A release guard (AB=11)
bmsetsimwindow	mask	0x1	Flag to determine which simultaneity window the bit detector should be set with: 0 - Zero 1 - 5 ms Having two bit transitions falling in the same 5 ms period is the definition of simultaneous bit transitions on the line. Double bit transitions are illegal in some countries.
meteringbit	mask	0xA	Determines whether to expect metering pulses on the C bit: A - A-bit B - B-bit C -0 C-bit 0 - None
bmrequirehalfecho	mask	0x0149	If set, a half-echo suppression is needed in international working (the outbound side answers with a I-14 to a A-14 request, in CCITT speech).
bmIndia	mask	0x0	Specifies whether or not the protocol is running in India: 0x0 - No 0x1 - Yes

Field	Type/ Unit	Default	Description
bmaltEOI	mask	0	Controls the time to wait for the outbound call to be answered: 0 - Use the normal procedure. 1 - Use alternate end-of-information procedure to give the application more time to answer a call.
bmIgnoreNonNumeric	integer	0	Specifies what to do with non-numeric address digits: 0 - Pass all digits to the host. 1 - Do not pass non-numeric digits to the host.
Digit masks In the following mask parameters, bits set to 1 represent valid digits. If the TCP receives a digit corresponding to a bit set to 0, it automatically rejects the call. For example, for the validDIDmask parameter below, the digits B, C, D and E are invalid DID digits.			

validDIDmask	mask	0x87FE	Valid DID tones in the target country. If a DID received by inbound is not valid, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`1000|0111|1111|1110`

validANImask	mask	0x97FE	Valid ANI tones in the target country. If a ANI is received by inbound, that is not valid, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`1001|0111|1111|1110`

validcategorymask	mask	0x07FE	Valid category tones in the target country. If an invalid category is received by inbound, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`0000|0111|1111|1110`

validgroupIImask	mask	0x07FE	Valid Group II tones in the country. If an invalid Group II tone is received by inbound, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`0000|0111|1111|1110`

catnoANImask	mask	0x0	Category tones that imply that no ANI digits follow. The mask is the following:
			`FEDC|BA98|7654|321-`
			`0000|0000|0000|0000`

Forward Group I tones that outbound plays to answer inbound's request for information about the presence or absence of a satellite link in the circuit, and the need for half-echo suppression.			
tnNoSatellite	mask	0xD	No satellite link in the circuit (A-13).
tnSatellite	mask	0xE	Satellite link in the circuit (A-14).

Field	Type/ Unit	Default	Description
tnEchoSuppressorRequired	mask	0xE	Half-echo suppression needed (A-14). If this is not the case, the outbound just ignores the request and plays any other tone.
reanswerdelay	ms	0	Time to wait for re-answer pulse. This might be needed for special switches in certain countries. Set to zero to disable.
reanswerpulsetime	ms	0	Length of re-answer pulse. Disabled if reanswerdelay is set to zero.

The following parameters are reserved for NMS internal use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *MFC-R2 editable parameters* on page 122 for more information.

MFC-R2 and NCC service call control

When applications receive calls using NCC service call control with the MFC-R2 protocol, they can receive digits in the following ways:

- All at once
- One at a time

Receiving digits all at once

For MFC-R2, after NCCEVN_INCOMING_CALL is received, the following fields of the NCC_CALL_STATUS structure contain information relevant to the call:

Field	Description
calledaddr	Called number. Also referred to as the direct inward dial (DID) number.
callingaddr	Calling number (if available). Also referred to as the automatic number identification (ANI) number.

For MFC-R2, after NCCEVN_INCOMING_CALL is received, the following fields of the NCC_CAS_EXT_CALL_STATUS structure contain information relevant to the call:

Field	Description
usercategory	Calling party category (Group I), for example, normal subscriber, operator, maintenance equipment.
anipresentation	ANI digits may not be available because of interworking of different protocols with different features in the call path, or ANI presentation might be restricted. Possible values include: 0 = Calling number presentation allowed (default) 1 = Calling number presentation restricted 2 = Calling number not available
tollcategory	Category associated with the calling party in register signaling Group II. Usually this is the same as the user category, but in some countries it carries the toll category of the call.

Several parameters affect the way the MFC-R2 TCP accepts, processes and presents the incoming digits to the host:

Parameter	Description
DIDnumber	Number of direct inward dial (DID) digits the TCP should expect from the calling party. Default is 7.
ANInumber	Number of automatic number identification (ANI) digits the TCP should expect. Set this number to one more than the number of ANI digits to expect, to include the category digit. For example, if the TCP is to expect 7 digits, set this parameter to 8 (the default). If this parameter is set to 0, no ANI digits are collected.
DIDBeforeANI	Number of DID digits the TCP should receive before signaling the calling party to send ANI digits. It defaults to 1.

When you call **nccAnswerCall** with MFC TCPs, the upper five bits of the number_of_rings argument are reserved, and should be set to zero. This means that the mfc0 TCPs can play a maximum of 0x7FF (2047) ring back tones when answering a call.

Receiving digits one at a time

To receive digits one at a time, make sure the Ncc.Start.OverlappedReceiving parameter is set.

For MFC-R2, digits appears in the following format:

d_1 # c_1 a_1 a_2 a_3 ... a_m # d_2 d_3 ... d_n # c_2

where:

Value	Description
d_1...d_n	DID digits received. ***n*** is determined by the NCC.X.ADI_MFC.DIDnumber parameter.
c_1	Group I category of the calling party (user category).
a_1 ... a_m	ANI digits received. ***m*** is determined by the NCC.X.ADI_MFC.ANInumber parameter.
c_2	Group II category of the calling party (toll category).
#	NMS separator symbol.

Note: The number of DID digits received before the first # separator depends on the parameter NCC.X.ADI_MFC.DIDbeforeANI.

16 NEC PBX protocol

NEC PBX signaling

The NEC PBX TCP implements the specifications of the 30 DLI (digital line interface) using PA-30DTS package, as specified in Annex 303-15-B 2/2 from NEC, NEC Australia PTY, LTD.

The NEC PBX protocol is generally a single B-bit signaling protocol. The exception to this is the blocking signal, which uses both A and B bits. The protocol is asymmetric between the TE side (user or application side) and the NT side (network or PBX side). The signaling channels supporting the line signaling of these protocols are referred to as A_f and B_f in the forward direction, and A_b and B_b in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment). The C and D bits are never used. Their value is fixed at 0 and 1 respectively.

The following table describes the signaling states of a typical inbound call originating from the PBX:

State	Outbound PBX A_fB_f	Direction	Inbound terminal A_bB_b
Idle	00	← →	00
Ring on	01	→	00
Ring off	00	→	00
At this point an incoming call is presented to the application. The application can answer or reject it. If the application answers the call, the line code changes to the conversation state line code after the outbound side re-asserts ring on B signaling bit.			
Ring on	01	→	00
Answer - conversation state	01	←	01
If the application rejects the call, the protocol does not respond to the ring signal. The calling party eventually abandons the call with the signaling bits for the outbound side remaining in the idle state. The application disconnects the call, as shown:			
Clear back	01	←	00
Idle	00	→	00

The following table illustrates the signaling states of a typical outbound call placed to the connecting PBX:

State	**Outbound terminal A_fB_f**	**Direction**	**Inbound PBX A_bB_b**
Idle	00	← →	00
Seizure	01	→	00
Seizure acknowledged	01	← Dial tone	00
Dialing	01	→ DTMF digits dialed	00
At this point the remote switch either answers or rejects the call. If the call is answered, the answer signal AB = 01 is asserted. The switch may provide ring tone before answering the call. The outbound TCP does call progress detection at this phase.			
Answer - conversation state	01	←	01
The application disconnects the call, as shown:			
Clear forward	00	→	01
Idle	00	←	00

NEC PBX parameters

The following table describes NCC.X.ADI_NEC parameters (within the parameter category NCC.X.ADI_NEC):

Field	Type/ Unit	Default	Description
trunkdirection	mask	0	Direction of the line. 0 - Two way 1 - Inbound only 2 - Outbound only
playcleardown	mask	1	Whether or not to play cleardown tone when disconnecting. 0 - No 1 - Yes
networkside	mask	0	0 - Run as TE side. 1 - Run as NT side. Run as NT side for testing purposes only.
nowaitfordialtone	mask	0	0 - Wait for dial tone before dialing digits 1 - Do not wait for dial tone before dialing digits
abortnodialtone	mask	1	0 - Proceed with dialing even if no dial tone is detected 1 - Abort the outbound call if dial tone is not detected
TmMinRingOn	ms	600	Minimum on time for the out-of-band signaling bit to have a valid ring signal.
TmMaxRingOn	ms	1400	Maximum on time for the out-of-band signaling bit to have a valid ring signal.
TmMaxRingOff	ms	2800	Maximum off time for the out-of-band signaling bit to have a valid ring signal.
TmRingOn	ms	1000	Ring on time used by network simulation.
TmRingOff	ms	2000	Ring off time used by network simulation.
MaxRings	count	5	Maximum number of ring cycles played before the network side times out with no answer as the disconnect cause.
TmBitQualification	ms	20	Minimum time required for a bit transition to be recognized. This time applies to states other than the connected state.
NmRingsSeizure	count	1	Number of ring cycles to wait before reporting an NCCEVN_INCOMING_CALL.
debug	mask	0	Debug mask. Reserved for NMS use.
TmWaitForRelease	ms	10000	Time waiting for the remote end to acknowledge a disconnect. If this timer expires, an NCCEVN_CALL_DISCONNECTED event is generated and the protocol enters a fault state, sending an out-of-service event to the application.
BusyFreqLo	Hz	425	Busy tone low frequency. Used as the cleardown tone.
BusyFreqHi	Hz	0	Busy tone high frequency. Used as the cleardown tone.
TmBusyOn	ms	500	Tone on time for the busy tone.
TmBusyOff	ms	500	Tone off time for the busy tone.
AmpCPTones	IDU	350	Amplitude of all call progress tones.

Field	Type/ Unit	Default	Description
bmCDBit	mask	1	Bit mask that specifies the value of the C and D bits (default is 1).
TmWaitAnswer	ms	10000	Time to wait for the remote end to answer. Used by the network side.
xferstring	string[6]	!;	Initial string to dial (excluding the number to transfer to) in performing a transfer operation. Meaning: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
connstring	string[6]	!	String to dial to reconnect after a transfer has failed. Meaning: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
TmQDisconnect	ms	1500	Minimum time required for a bit transition to be recognized while in the connected state.
TmPredial	ms	200	Pre-dial delay for dialing digits in a transfer command.
TmPreDigitDelay	ms	1000	Pre-dial delay for dialing digits in normal calling.
Tm1stDigit	ms	10000	Time to wait for the first DTMF digit on an inbound call. Network side only.
TmDigitOn	ms	1000	Inbound digit stuck on timer. Network side only.
TmInterDigit	ms	1000	Inbound inter-digit timeout. Network side only.
NmDigits	count	4	Number of digits to expect in called party number. Network side only.
TmWaitDialTone	ms	3000	Time to wait for dial tone before proceeding with outbound call.
TmDTMF_ON	ms	80	DTMF on time (for playing DTMF tones).
TmDTMF_OFF	ms	80	DTMF off time (inter-digit time used in playing DTMF strings).
FrRingLo	Hz	425	Low frequency of audible ring tone. Network side only.
FrRingHi	Hz	0	High frequency of audible ring tone. Network side only.
TmARingOn	ms	1000	On time of audible ring. Network side only.
TmARingOFF	ms	2000	Off time of audible ring. Network side only.
resourcegettimes	ms	0xa0f	Reserved for NMS use.

17 Off-premises station (OPS) protocol

OPS signaling

OPS protocols exist in both analog and digital variations. The NMS OPS TCP covers digital interfaces. The protocol can handle T1 or E1 digital trunks, of signaling types FX (foreign exchange) or SA (special access). The trunk and signaling type is determined using the trunktype parameter.

If you used LPS8 or LPS9 protocols in the past, you should now migrate to the off-premises station (OPS) protocol.

Although E1 channel associated signaling (CAS) framing supports four signaling bits per direction, only two of them are used for OPS line signaling. The signaling channels supporting the OPS line signaling protocol are referred to as A_f and B_f in the forward direction, and A_b and B_b, in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

The other bits in either direction (the C and D bits) usually have fixed values. However, their values may change from network to network.

The following tables describe digital OPS signaling in the two cases of FX and SA. Two tables are necessary because the protocol changes depending on the side that started the call.

The following table describes the case in which the switch presents the call to the terminal equipment:

State	**Outbound switch A_fB_f (STA)**	**Direction**	**Inbound terminal A_bB_b (OPS)**
Idle	01 (FX) 11 (SA)	⟵ ⟶	01 (FX) 00 (SA)
Ring on	00 (FX) 10 (SA)	⟶	01 (FX) 00 (SA)
Ring off	01 (FX) 11 (SA)	⟶	01 (FX) 00 (SA)
At this point, the incoming call is presented to the application. The application can answer or reject it. If the application answers it, the line code changes to the conversation state code.			
Answer - conversation state	01 (FX) 11 (SA)	⟵	11 (FX) 10 (SA)
If the inbound side application rejects the call, the OPS TCP does not pick up the phone, and the calling party abandons the call.			
If the switch side clears the call, a cleardown tone might be on the line. The terminal responds to this by hanging up the call.			
Clear and idle	01 (FX) 11 (SA)	⟵	01 (FX) 00 (SA)

The following table illustrates the case in which the terminal equipment places the call:

State	**Outbound terminal A_fB_f (OPS)**	**Direction**	**Inbound switch A_bB_b (STA)**
Idle	01 (FX) 00 (SA)	⟵ ⟶	01 (FX) 11 (SA)
Seizure	11 (FX) 10 (SA)	⟶	01 (FX) 11 (SA)
Seizure acknowledged	11 (FX) 10 (SA)	⟵ Dial tone	01 (FX) 11 (SA)
The outbound side starts to send the address information. This can be done using DTMF tones or decadic pulses. If the method is decadic pulses, the loop A_f bit is switched off (pulse on) and on (pulse off) repeatedly to signal the digits.			
Call progress tones	11 (FX) 10 (SA)	⟵ Ring tone	01 (FX) 11 (SA)
If the called switch rejects the call, the terminal detects the busy tone on the line and abandons the call. Or, if the called switch does not answer, the terminal abandons the call after a parameterized number of rings.			
Answer - conversation state	11 (FX) 10 (SA)	⟵ Voice	01 (FX) 11 (SA)
If the switch side clears the call, a cleardown tone might be on the line. The terminal responds to this by hanging up the call.			
Clear and idle	01 (FX) 00 (SA)	⟶	01 (FX) 11 (SA)

OPS editable parameters

To program the off-premises station TCP to operate within different countries and network, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_OPS. You can modify the TCP/host interaction that configures unregulated features or modifies features that vary from switch to switch within the same network.

The following table describes NCC.X.ADI_OPS editable parameters (within the parameter category NCC.X.ADI_OPS):

Field	Type/ Units	Default	Description
nodialtonebehavior	mask	0x0	Determines what to do if no dialtone is detected: 0 - TCP hangs up and abandons the call 1 - TCP proceeds to dial anyway
transfersupport	mask	0x0	Selects whether PBX transfer is allowed: 0 - Transfer commands are disabled 1 - Transfer commands are allowed
CIDsupport	mask	0x0	Indicates if caller ID is supported: 0 - CID disabled 1 - CID enabled
cleardowntone	mask	0x1	If network side, tone to play as dial tone (if 0, do not play cleardown tone): 1 - Play dial tone as cleardown tone 2 - Play busy tone as cleardown tone 3 - Play reorder (fast busy) as cleardown tone
cleardownflag	integer	1	Turns on cleardown detection: 0 - Off 1 - On
hangupsignal	mask	0x1	Flags that control the bit that signals hang up supervision. The cleardown tone is always detected. 0x1 - Hang up supervision on the A bit (default) 0x2 - Hang up supervision on the B bit
trunktype	mask	0x0	Determines the trunk type: 0 - T1 1 - E1
signalingtype	mask	0x0	Determines the signaling type: 0 - Foreign exchange (FX) 1 - Special access (SA)

Refer to *OPS non-editable parameters* on page 139 for more information.

OPS non-editable parameters

The following NCC.X.ADI_OPS parameters cannot be modified.

Caution:	Most of the parameters that follow are signaling specific: changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Units	Default	Description
bitqualtime	ms	10	Qualification time for bit detector.
minringontime	ms	100	Minimum duration of incoming ring.
maxringontime	ms	3000	Maximum duration of incoming ring.
maxringofftime	ms	8000	Maximum duration of silence between rings.
ringstoincoming	count	1	Number of rings to detect for an incoming call: 0 - 1st ring begin 1 - 1st ring end ***n*** after ***n*** rings If caller ID is enabled (optionflags bit 3 = 1), the incoming call is reported after at least one ring.
dialtonewaittime	ms	5000	For outgoing calls, the maximum time to wait for initial dial tone.
dialtonemintime	ms	1000	For outgoing calls, the minimum duration of non-precise dial tone required before dialing will begin. Set this to 0 to disable non-precise dial tone detection. (Precise dial tone detection is controlled by NCC.START parameters).
releaseguardtime	ms	1000	Minimum time between hang up and off hook.
CIDtype	integer	0	Type of caller ID protocol, if CID is enabled. 0 - BellCore CID protocol 1 - NTT Japan CID protocol 2 - ETSI CID protocol (V.23)
CIDmaxwaittime	ms	5000	Maximum time to wait for caller ID to arrive before concluding the caller has hung up (if CID is enabled).
CIDmaxalerttime	ms	0	Maximum duration of an alert signal in caller ID protocol (if CID is enabled).
CIDminmarktime	ms	100	Minimum duration of the mark signal of the caller ID protocol that is interpreted as such.
xferstring	string[6]	!;	Prefix dial string for call transfer. The string is dialed before dialing the number, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing

Field	Type/ Units	Default	Description
connstring	string[6]	!	String for transfer back to the connected state with the first call. It is dialed if a call transfer fails, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
connectbacktime	ms	100	Time to wait after sending transfer back hookflash if the PBX was playing busy.
waitdialnodialtone	ms	500	Time to wait to dial if no dialtone detection is required.

The following parameters are reserved for NMS internal use:

- ringsignalontime
- ringsignalofftime
- numdigits
- alarmsonqualtime
- alarmsoffqualtime

Refer to *OPS editable parameters* on page 138 for more information.

18 Operator workstation (STA) protocol

STA signaling

The operator workstation protocol implements the PBX side of a loop start connection. The protocol talks with analog phones over a local loop link. It is implemented by the STA0 TCP.

This protocol requires an NMS analog board to operate. The board must be capable of providing loop current and ring voltage to a passive terminal. AG 2000 boards have configurations that support this capability.

For information about transmitting an FSK caller ID sequence between the ring cycle while running the STA protocol, see *Caller ID generation with the STA protocol* on page 177.

The following tables describe operator workstation signaling. Two tables are necessary because the protocol changes depending on the side that starts the call.

AG 2000 presents the call to the terminal equipment

The following table describes the case where the AG 2000 (for instance using the NMS STA0 TCP) presents the call to the terminal equipment:

State	Outbound AG 2000	Line/Direction	Inbound terminal
Idle	N/A	No loop current	
Ringing	Apply ringing voltage	Ringing voltage	(Telephone rings)
At this point, the call can be answered. If it is answered, the phone is picked up, and loop current flows in the circuit. If the call is not answered after a certain number of rings, the STA0 TCP abandons the call. The protocol does not support connect on proceeding because the outbound protocol must apply a ring signal to the inbound side. Connecting on proceeding would bypass this state and, therefore, the inbound side would not ring.			
Answer - conversation state		← Loop current, voice	Off-hook
AG 2000 clears first (optional)		Loop current interruption, or cleardown tone	
Clear		← Loop current interruption	On-hook
Idle		No loop current	

Terminal equipment places a call to the AG 2000

The following table describes the case where the terminal equipment places a call to the AG 2000:

State	Outbound terminal	Line/Direction	Inbound AG 2000
Idle		No loop current	
Seizure	Off-hook	Loop current	
Seizure acknowledge		← Dial tone	
The outbound side starts to send the address information using DTMF tones or decadic pulses. If the method is decadic pulses, the loop current goes on (pulse on) and off (pulse off) repeatedly to signal the digits. When the address information has been completely received, the STA0 TCP presents the call to the application. The application must then decide if the call is to be accepted or rejected. If the call is accepted, the STA0 TCP plays a ring tone on the line.			
Call progress tones		← Ring tone	
If the call is rejected, the STA0 TCP plays a busy tone on the line. The terminal is expected to abandon the call and turn off loop current.			
Answer - conversation state		← Voice	
AG 2000 clears first (optional)		← Loop current interruption, or cleardown tone	
Clear	On-hook	→ Loop current interruption	
Idle		No loop current	

Loop start protocol on digital CAS trunks

The STA0 protocol can also be used to implement the network side of loop start protocol on digital CAS trunks. These can be provisioned on boards such as the AG 4040 and CG 6000 series boards.

For an example that shows the signaling bits for the loop start protocol on digital CAS trunks, refer to *OPS signaling* on page 135.

To use the STA0 protocol on a digital trunk, you must set the linetype and CDsignalbits parameters appropriately.

STA parameters

The following table describes operator workstation (NCC.X.ADI_STA) parameters:

Field	Type/ Unit	Default	Description
numdigits	count	3	Number of inbound digits to expect.
wait1stdigittime	ms	7000	Time to wait for first digit after loop current on.
waitfordigitstime	ms	8000	Time to wait for each subsequent digit.
defaultrejecttone	count	3	Tone to play if NCC.START.waitforPCtime expires: 1 - Ring 2 - Busy 3 - Fast busy (reorder)
releasecallbehavior	count	3	Cleardown tone to play or action to take when releasing a call first: 0 - No action 1 - Loop current interruption (no cleardown tone) 2 - Dial tone 3 - Busy 4 - Fast busy (reorder)
playdialtone	mask	0x1	What to do after seizure: 0 - Do not play dial tone after seizure 1 - Play dial tone after seizure
blockplayreorder	mask	0x0	Blocking tone to play or action to take: 0 - Play reorder 1 - No loop current
maxringseconds	seconds	60	Maximum time to keep ringing when placing an outbound call.
loopdroptime	integer	750	Time to drop loop current during release of an outbound call, in seconds (if loop current interruption is the chosen release method).
cidsupport	integer	0x00	Type of caller ID to generate: Low four bits (hexade): 0 - Disabled 1 - Bellcore 3 - ETSI High four bits (hexade): 0 - Normal ring alerting signal 1 - Ring pulse alerting signal 2 - Dual tone alerting signal
qualaddron	ms	50	Loop current on qualification time during addressing.
qualaddroff	ms	50	Loop current off qualification time during addressing.
qualdisconnect	ms	150	Qualification time of loop current off during the connected state.
qualpermsignal	ms	60000	Qualification time of loop current on when disconnecting or blocking, to declare line out-of-service.

Field	Type/ Unit	Default	Description
outring1ontime	ms	1000	Duration of ring voltage for first ring in cycle, while placing a call.
outring1offtime	ms	3000	Duration of ring voltage off for first ring in cycle, while placing a call.
outring2ontime	ms	0	Duration of ring voltage for second ring in cycle, while placing a call (for UK-style ringing cycles, for example, 400 on, 200 off, 400 on, 2000 off).
outring2offtime	ms	0	Duration of ring voltage off for second ring in cycle, while placing a call (for UK-style ringing cycles, for example, 400 on, 200 off, 400 on, 2000 off).
maxflashtime	ms	650	Maximum flash-hook duration. The interaction with qualdisconnect that in this case represents the minimum time.
linetype	mask	0x0	Type of line used for call: 0 - Analog (AG 2000) 1 - Digital OPS foreign exchange (FX) 2 - Digital OPS special access (SA)
CDsignalbits	mask	0x0	If the linetype setting is a digital trunk, then: 0 - CD bits = AB bits (normal T1) 1 - CD bits = 01 (normal E1) 2 - CD bits = 10 3 - CD bits = 11

19 Pulsed E and M (EAM) protocol

EAM signaling

The protocol known as pulsed E and M (EAM) is defined by national specifications in a few countries. For compatibility with older analog equipment, this protocol exploits MFC-R2 compelled register signaling (as defined by the CCITT in Recommendations Q.441, Q.442) while using only one bit for line signaling.

The pulsed E and M protocol uses one bit in each direction for line signaling. The bit is pulsed. A signal is defined by the bit being flipped from its idle value, and being flipped back after a certain time. Two types of pulses are defined, long and short. They carry different meanings in the context of the current state of a call.

Different countries use different bits to implement line signaling, with different idle states.

This topic describes:

- Signaling states
- Register signaling

Signaling states

The following table describes the signaling states of a typical call:

State	Outbound	Direction	Inbound
Idle	Idle code	← →	Idle code
Seizure	Short pulse	→	Idle code
Seizure acknowledged	Idle code	←	Short pulse (usually not necessary)
The outbound side starts to send the address information using in-band compelled MF tones. The inbound side completes the compelled sequence by accepting or rejecting the call, using the last backward compelled tone. If the call is accepted, the inbound side plays a ring tone on the line, and then signals that the call was answered.			
Ringing	Idle code	←	Idle code
Answer - conversation state	Idle code	←	Short pulse
If the inbound side rejects the call, the outbound side clears forward by sending a long pulse. The inbound side acknowledges with another long pulse, and the line is back in the Idle state.			
Clear forward	Long pulse	→	Idle code
Idle	Idle code	←	Long pulse

State	Outbound	Direction	Inbound
During conversation, the outbound protocol can receive billing pulses to signal that a unit of cost has been billed to the call. A billing pulse is always a short pulse.			
Answer - conversation state	Idle code	← →	Idle code
Billing pulses	Idle code	←	Short pulse
Answer - conversation state	Idle code	← →	Idle code
Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. If outbound sends a clear forward signal, inbound always acknowledges with a release guard signal. If inbound sends a clear back, outbound sends a clear forward. Depending on national specifications, inbound can still be required to acknowledge with a release guard. Idle follows.			
Inbound hangs up first: Clear back	Idle code	←	Long pulse
Clear forward	Long pulse	→	Idle code
Release guard (in some countries)	Idle code	←	Long pulse
Idle	Idle code	← →	Idle code
Outbound hangs up first: Clear forward	Long pulse	→	Idle code
Release guard	Idle code	←	Long pulse
Idle	Idle code	← →	Idle code

Register signaling

The pulsed E and M protocol uses the same multiple-frequency compelled scheme as the MFC-R2 protocol to perform register signaling.

The outbound exchange starts by putting on the line a forward tone that represents the first digit of the called address. The inbound exchange detects the tone, and answers with a backward tone, which acknowledges the previous forward tone and requests another digit. The inbound exchange can use different tones in the backward direction, each carrying a request for a different piece of information. The outbound exchange interprets the request and sends the appropriate digit.

When the outbound exchange detects the backward tone, it stops the current forward tone. When the inbound exchange detects the end of the forward tone, it stops its backward tone. When the outbound exchange detects the end of the backward tone, it starts the next tone, representing the next digit, and the cycle is repeated.

Different kinds of information are transferred from the outbound to the inbound exchange in this way. The pulsed E and M protocol supports:

- DID digits (called party address)
- ANI digit (calling party address)
- Caller category (for instance, normal subscriber, pay phone, operator)
- Caller toll category (in some countries)
- The information indicating if the call is to be billed or free

The NMS pulsed E and M protocol implementation gives developers control over all of these features.

EAM editable parameters

To program the pulsed E and M TCP to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_EAM. You can modify parameters that program TCP/host interaction, that configure unregulated features, or that configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_EAM editable parameters (within the parameter category NCC.X.ADI_EAM):

Field	Type/ Unit	Default	Description
DIDnumber	count	7	Inbound: Number of DID digits to expect.
ANInumber	count	8	Inbound: Number of ANI digits to expect.
DIDBeforeANI	count	1	Inbound: Number of DID digits to receive before asking for category.
nobusyonReject	mask	0x0	Determines if the TCP plays busy when rejecting a call. If not, the switch does it instead. 1 - Do not play 0 - Play (default)
trunkdirection	mask	0x0	Determines trunk direction: 0 - Bidirectional 1 - Inbound only (no calls can be placed on it) 2 - Outbound only (no calls can be received on it)
cleardowntone	mask	0x1	Determines if a cleardown tone (busy tone) is necessary when the inbound side of the TCP hangs up a call first: 0 - No cleardown tone is played 1 - Play cleardown tone
norejtoneUserAudio	mask	0x0	Use this parameter if you need to play a message while rejecting a call. If set to 1, the TCP sends to the backward Group B tone the network to accept the call, thus causing the network to establish the voice path. The TCP then waits for the far end to hang up while the application plays a message.

Field	Type/ Unit	Default	Description
askrepeat	mask	0x0	If set to 1, the TCP asks the network to send the complete ANI digit string for an inbound call. If 0, the network may send partial ANI.
timewaitdial	ms	500	Outbound: Inactive time between the end of an outbound call and the next outbound call. Needed to synchronize the parties in those cases when a release guard signal is not in the protocol.

Refer to *EAM non-editable parameters* on page 148 for more information.

EAM non-editable parameters

The following NCC.X.ADI_EAM parameters instead are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Unit	Default	Description
The following parameters specify the signaling timers:			
Compelled timers			
compelledT1	ms	1500	T1: forward tones max on-time.
compelledT2	ms	2700	T2: forward tones max off-time.
compelledT3	ms	1500	T3: inbound compelled cycle timer.
Pulse timers: Specify the duration and tolerance of short and long signaling pulses (in one hundredths of a second). The pulses are generated with the nominal time value, and detected within nominal value ± tolerance.			
shortpulsetime	ms	150	Determines the nominal duration of short signaling pulses.
maxshortpulsetime	ms	150	Determines the tolerance of short signaling pulses.
longpulsetime	ms	600	Determines the nominal duration of long signaling pulses.
maxlongpulsetime	ms	300	Determines the tolerance of long signaling pulses.
seizureacktime	ms	0	Outbound: Time to wait for seizure acknowledgement before clearing forward. The seizure acknowledgment signal is defined only in the case of particular network variations, such as satellite connections. A value of 0 instructs the TCP not to expect a seizure acknowledge signal when dialing out.

Field	Type/ Unit	Default	Description
Miscellaneous timers:			
waitforanswertime	count	90	Time to wait for inbound to answer the call after all digits have been delivered, before clearing forward (in seconds).
waitforreleasetime	count	90	Time to wait for a release guard signal after clearing forward before starting an alarm recovery sequence (in seconds).
alarmtimeout	count	300	Outbound: Time in seconds to keep performing the alarm recovery sequence before setting the alarm bit. The alarm recovery sequence is as follows: the TCP seizes the line with a short pulse, then clears forward with a long pulse, and waits for a release guard signal from inbound. If the release guard signal is not received, the sequence is repeated periodically.
alarminterpulse	ms	300	Outbound: Time between short and long pulse in the alarm recovery sequence.
The following parameters contain the specification of all the tones needed by the protocols to implement the country-specific variation of R2. Each parameter holds more than one tone. Each tone uses four bits (one hexade) of the 16-bit word. Hexades are listed from least to most significant inside each parameter. Backward Group A tones. The TCP uses these tones to send requests to the calling party during the compelled sequence:			
tnGAsendnextDID	mask	0x1	Send next DID (A-1).
tnGAsendCAT	mask	0x5	Send Group I category (A-5).
tnGAsendnextANI	mask	0x5	Send next ANI (A-5).
tnGAswitchtoGB	mask	0x3	Send Group II tone (and switch to group B tone reception) (A-3).
Some backward Group B tones. The TCP uses these tones to send the final indication of the compelled sequence to the calling party:			
tnGBcongestion	mask	0x4	Congestion (B-4). This is also applicable during Group A transmission.
tnGBunallocnumber	mask	0x5	Unallocated number (B-5).
tnGBlinebusy	mask	0x3	Busy (B-3).
tnGBlineoutoforder	mask	0x8	Line out of order (B-8).
Forward tones that indicate the end or the non-availability of a certain type of information:			
tnDIDeoi	mask	0xF	End of DID digits. (I-15) In some countries this tone does not exist. In this case the parameter is 0.
tnNoCategory	mask	0xC	Caller's category. In some countries the category must be available to the caller, so the parameter is 0.
tnANIeoi	mask	0x8	End of ANI digits (I-15) - caller id available.

Field	Type/ Unit	Default	Description
Backward tones indicating acceptance of the call:			
tnanswerGBtoll	mask	0x6	Call accepted in Group B - charge (B-6).
tnanswerGBfree	mask	0x7	Call accepted in Group B - free call (B-7).
tnanswerGA	mask	0x6	Call accepted in Group A (A-6).
tnaltGB	mask	0x0	Alternative tone for call accepted in Group B (not in CCITT specifications, but necessary in some countries, such as CZH).
Request or indication tones used in different contexts by the TCP:			
tnoutGIIcategory	mask	0x1	The tone the outbound part of the TCP plays in Group II (toll category in some countries) (II-1, normal subscriber).
tnGIcategory	mask	0x1	Default user category (Group I category) to use if the application does not provide it. In some countries the outbound must play it in all cases (I-1, normal subscriber).
tnGIANInotavailable	mask	0xC	Tone meaning that after the user category no ANIs are available (I-12, or 0xC).
tnGIIfreecategory	mask	0x0	Free category - II-3 (maintenance equipment).
Request or indication tones used in different contexts by the TCP:			
tnA2RepeatLastMinus7DID	mask	0x2	Repeat digit ***n***-1 (A-2), where ***n*** is the DID digit that the outbound side last played.
tnA2RepeatLastMinus2DID	mask	0x7	Repeat digit ***n***-2 (A-7).
tnA2RepeatLastMinus3DID	mask	0x8	Repeat digit ***n***-3 (A-8).
tnA2RepeatAllDID	mask	0x02	Repeat all digits (restart dialing). Not specified by the CCITT Blue Book, but used in many countries.
Backward tones that the inbound plays when it is collecting ANIs (the specifications of some countries identify a Group C in this case);			
tnSendNextDIDfromANI	mask	0x1	Request the outbound to go back to sending DIDs, and send the next DID. This is typically the same as the normal send DID tone (tnGAsendnextDID), but it can be different in some countries, such as Mexico.
tnRepeatLastDID	mask	0x0	Request the outbound to go back to sending DIDs, and repeat the last DID transmitted. Not supported by the CCITT Blue Book (C-6).
Miscellaneous parameters			
compelledtoneslevel	IDU	330	R2 tones amplitude (forward and backward).
idlecode	mask	0xB	Idle code (ABCD - 1011).
pulsecode	mask	0xF	Line code during pulse (AB - 11).
alarmcode	mask	0x3	Line code during alarm (AB - 00). If same as idle code, no alarms are handled.

Field	Type/ Unit	Default	Description
doalarms	mask	0x1	Determines whether outbound signals alarms. 0 = No 1 = Yes
releaseguard	mask	0x1	Determines whether release guard is needed. 0 = No 1 = Yes
clearback	mask	0x1	Determines whether clear back is needed after clear forward. 0 = No 1 = Yes
twoclearforward	mask	0x1	Determines whether the protocol sends more than one clear forward before setting alarm status. 0 = No 1 = Yes
satelliteconnection	mask	0x0	Determines if seizure acknowledgment is needed. 0 = No 1 = Yes
nodigitbehavior	mask	0x1	Specifies no digit behavior. 0 = Pulse congestion 1 = Go to Group II
Digit masks In the following mask parameters, bits set to 1 represent valid digits. If the TCP receives a digit corresponding to a bit set to 0, it will automatically reject the call. For example, for the validDIDmask parameter below, the digits B, C, D and E are invalid DID digits.			

validDIDmask	mask	0x87FE	Valid DID tones in the target country. If a DID is received by inbound, that is not valid, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`1000|0111|1111|1110`

validANImask	mask	0x97FE	Valid ANI tones in the target country. If an ANI is received by inbound, that is not valid, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`1001|0111|1111|1110`

validcategorymask	mask	0x97FE	Valid category tones in the target country. If an invalid category is received by inbound, the compelled sequence is aborted with a congestion indication.
			The mask is the following:
			`FEDC|BA98|7654|321-`
			`0000|0111|1111|1110`

Field	Type/ Unit	Default	Description

noANIfollowmask	mask	0x9000	Specifies the values of ANIs, implying that no ANIs follow. The mask is the following:
			`FEDC|BA98|7654|321-`
			`1001|0000|0000|0000`

categorynoANImask	mask	0x0	Specifies the category tones that imply that no ANIs follow (a possibility for international calls). The mask is:
			`FEDC|BA98|7654|321-`
			`0000|0000|0000|0000`

clearbackdelay	ms	1000	If not equal to zero (0), specifies time to wait before reject collect calls clearback pulse. This might be needed for special switches in certain countries. Set to 0 to disable.
reanswerdelay	ms	2000	Specifies time after reject collect calls clearback pulse and before reanswer. Disabled if NCC.X.ADI_EAM.clearbackdelay is set to 0.

The following parameters are reserved for NMS internal use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *EAM editable parameters* on page 147 for more information.

EAM and NCC service call control

When applications receive calls using NCC service call control with the EAM protocol, they can receive digits in the following ways:

- All at once
- One at a time

Receiving digits all at once

For EAM, after NCCEVN_INCOMING_CALL is received, the following fields contain the received digits in the NCC_CALL_STATUS structure:

Field	Description
calledaddr	Called number. Also referred to as the direct inward dial (DID) number.
callingaddr	Calling number (if available). Also referred to as the automatic number identification (ANI) number.

For EAM, after NCCEVN_INCOMING_CALL is received, the following fields contain the received digits in the NCC_CAS_EXT_CALL_STATUS structure:

Field	Description
usercategory	Calling party category (Group I), for example, normal subscriber, operator, maintenance equipment.
ANIpresentation	ANIs may not be available because the application is using protocols where call path, or ANI presentation are restricted. Possible values include: 0 = calling number presentation allowed (default) 1 = calling number presentation restricted 2 = calling number not available
tollcategory	Category associated with the calling party in register signaling Group II. Usually this is the same as the user category, but in some countries it carries the toll category of the call.

Several entries in the TCP parameter file affect the way pulsed E and M TCPs accept and process digits.

Note: When you call **nccAnswerCall** with EAM TCPs, the upper five bits of the number_of_rings argument are reserved and should be set to zero. This means that EAM TCPs support a maximum of 0x7FF (2047) rings.

EAM parameter	Description
NCC.X.ADI_EAM.DIDnumber	Number of direct inward dial (DID) digits the TCP should expect from the calling party. Default is 7.
NCC.X.ADI_EAM.ANInumber	Number of automatic number identification (ANI) digits the TCP should expect. Set this number to one more than the number of ANI digits to expect, to include the category digit. For example, if the TCP expects 7 digits, set this parameter to 8 (the default). If this parameter is set to 0, no ANI digits are collected. However, the TCP always tries to collect the user category of the calling party and present it to the application.
NCC.X.ADI_EAM.DIDBeforeANI	Number of DID digits the TCP should receive before signaling the calling party to send ANI digits. Default is 1.

Refer to *Configuring TCPs* on page 23 for information about loading parameter files.

Receiving digits one at a time

For pulsed E and M, the digits appear in the following format:

d_1 # c_1 a_1...a_m # d_2 d_3...d_n # c_2

where:

Value	Description
d_1...d_n	DID digits received. ***n*** is determined by the NCC.X.ADI_EAM.DIDnumber parameter.
c_1	Group I category of the calling party (user category).
a_1 ...a_m	ANI digits received. ***m*** is determined by the NCC.X.ADI_EAM.ANInumber parameter.
c_2	Group II category of the calling party (toll category).
#	NMS separator symbol.

Note: The number of DID digits received before the # separator depends on the NCC.X.ADI_EAM.DIDbeforeANI parameter.

20 Signaling system 5 (SS5) protocol

SS5 signaling

The SS5 TCP implements the CCITT Recommendations Q.140-Q.164, *Specifications of Signaling System No. 5*, CCITT Red Book, Volume VI, Fascicle VI.2, Geneva 1985.

SS5 line signaling is performed by in-band compelled single or dual-frequency tones. Two frequencies are used, either alone or in combination:

- f_1 = 2400 Hz
- f_2 = 2600 Hz

These frequencies are sufficiently far apart from the register signaling tones not to cause any false detection, and are in a frequency band where the likelihood of a false detection due to voice is minimal.

Since no signaling bits are involved, this is not strictly a digital CAS protocol, but can be used on analog trunks as well. However, the NMS implementation is for digital boards.

Note: The SS5 protocol can be used to set up calls on both T1 and E1 trunks.

This topic describes:

- Signaling states
- Signal exchange

Signaling states

The following table describes line signaling for a typical call:

State	Forward tone	Direction	Backward tone
Idle	None		None
Seizure	f_1 (2400 Hz)	→	
Proceed to send		←	f_2 (2600 Hz)
The outbound side starts to send the address information using in-band MF tones. Call setup continues with the inbound side playing a ring-back tone if the call is accepted, and then answering the call.			
Ringing		←	Ring tone
Answer		←	f_1 (2400 Hz)
Answer acknowledge	f_1 (2400 Hz)	→	
If the inbound side rejects the call, the tone played is different.			
Busy-flash		←	f_2 (2600 Hz)
Busy-flash acknowledge	f_1 (2400 Hz)	→	
Idle	None		None
A busy-flash tone may not be played at this time to reject a call. Instead, the busy tone of the target network is played. Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. A clear back signal must be acknowledged by the outbound side, then a clear forward signal is sent, acknowledged by a release guard signal. Idle follows.			
Inbound hangs up first: Clear back		←	f_2 (2600 Hz)
Clear back acknowledge	f_1 (2400 Hz)	→	
Pause: Two consecutive signals in the same direction	100 ms minimum		
Clear forward	$f_1 + f_2$ (2400+2600 Hz)	→	
Release guard		←	$f_1 + f_2$ (2400+2600 Hz)
Idle	none		none
Outbound hangs up first: Clear forward	$f_1 + f_2$ (2400+2600 Hz)	→	
Release guard		←	$f_1 + f_2$ (2400+2600 Hz)
Idle	None		None

Signal exchange

The signals are exchanged following a compelled scheme. The exchange is as follows:

1. Side A starts playing a tone.
2. When side B detects the tone, it starts playing its tone.
3. When side A detects side B's tone, it stops playing its tone.
4. When side B detects silence, it stops playing the tone it was playing.

Thus, there is no fixed timing, but the whole cycle proceeds at the maximum speed allowed by the tone detection and generation equipment.

Register signaling is implemented by in-band MF tones that the outbound equipment sends to the inbound equipment. These tones are unacknowledged. The relevant address is preceded by a KP tone (start-of-pulsing) and ended by an ST tone (end-of-pulsing).

SS5 editable parameters

To program the SS5 TCP to operate within different countries and networks, modify the TCP-specific parameters stored within the parameter category NCC.X.ADI_SS5. You can modify parameters that program TCP/host interaction, that configure unregulated features or that configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_SS5 parameters (within the parameter category NCC.X.ADI_SS5) that you can modify.

Field	Type/ Unit	Default	Description
numdigits	count	7	Relevant to inbound protocol. Specifies the number of incoming digits to expect. This value is overridden if the outbound party sends an ST (end of dialing) tone. An ST tone is foreseen in the CCITT specifications, but can be missing.
variabledigits	mask	0x0	Inbound: Determines what to do if a timeout occurs during digit reception: 0 - Reject the call 1 - Notify the host of an inbound call This value is only valid if the ST tone is missing.

Refer to *SS5 non-editable parameters* on page 158 for more information.

SS5 non-editable parameters

The following NCC.X.ADI_SS5 parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Unit	Default	Description
Line signaling timers - during different phases of the protocol.			
intersignaltime	ms	100	Minimum time between two line signals in the same direction. Must be kept for signal qualification reasons.
longqualtime	ms	125	Qualification time of almost all signaling tones. A tone must be present on the line for at least this duration to be recognized.
shortqualtime	ms	40	Qualification time of the seizure or proceed to send compelled signal. It is shorter to minimize the possibility of glare.
connectqualtime	ms	1000	Qualification time during the connected phase of a call. It is longer to minimize the possibility of talkoff (voice being erroneously recognized as a line signal).
glarewaittime	ms	850	Time to wait for the seizure signal to stop, if glare occurs. If an outbound protocol seizes the line by playing a seizure tone, and subsequently recognizes a tone on the line that is not the proceed-to-send tone, it must wait for this time for the other tone to stop.
signalcompelledtime	ms	10000	First compelled signal maximum duration.
ackcompelledtime	ms	4000	Acknowledgment compelled signal maximum duration.
compelledtoneslevel	IDU	250	Amplitude of compelled line signaling tones.
Register signaling timers for the inbound protocol			
waitKPtime	ms	7000	Inbound: Max time to wait after seizure acknowledge for the KP start of dialing digit to arrive.
waitdigittime	ms	8000	Inbound: Max time to wait for every next digit.
Register signaling parameters for the outbound protocol			
outdialdelay	ms	100	Outbound: Time to wait after receiving the proceed-to-send signal, before starting to dial.
KPandSTontime	ms	100	Outbound: Duration of the KP and ST tones.
MFtoneontime	ms	55	Outbound: Duration of MF tones.
MFtoneofftime	ms	55	Outbound: Duration of silence between MF tones.
MFtoneslevel	IDU	352	Outbound: Amplitude of MF tones.
outboundguardtime	ms	300	Outbound: Time after an outbound call in which the TCP will not place another call.

The following parameters are reserved for NMS mask use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *SS5 editable parameters* on page 157 for more information.

SS5 and NCC service call control

When applications perform NCC service call control with the SS5 protocol, they can process digits in the following ways:

Method of processing digits	Description
Inbound calls: Receiving digits all at once	With SS5 TCPs, after NCCEVN_INCOMING_CALL is received, the calledaddr field in the NCC_CALL_STATUS structure contains all received digits. The callingaddr, usercategory and tollcategory fields are NULL. The parameter NCC.X.ADI_SS5.digitnumber determines the number of digits the TCP should expect from the calling party. The default is 7.
Inbound calls: Receiving digits one at a time	The SS5 TCP does not recognize ANI or category digits. Digits are presented in the order in which they arrive. The NCC.X.ADI_SS5.digitnumber parameter determines how many digits to expect, but is active only if the outbound party does not send an ST tone (end of dial) at the end of register signaling.
Outbound calls: Formatting digits	Two KP digits are possible in the SS5 protocol. These are KP1 (D, the starting digit for national calls), and KP2 (E, the starting digit for international calls). KP1 is the default KP tone, so if the application wants to use KP1 as the starting digit, the ***callingaddr*** argument used with **nccPlaceCall** is formatted as follows: $d_1 \ldots d_n$ If the application wants to send a different KP digit, the ***callingaddr*** argument used with **nccPlaceCall** is formatted as follows: # KP# $d_1 \ldots d_n$ (where # is a conventional NMS separator)

Caller ID is not supported in SS5 TCPs.

21 System R1.5 (R15) protocol

R15 signaling

R15 TCPs implement a number of different protocols used in the Russian telephone network. The protocols run on E1 trunks. Two separate TCPs are used for inbound and outbound calls, since the protocols' structure excludes the possibility of two-way trunks. They are named *r150.tcp* and *r151.tcp*. Separate call setup schemes are used for local and long distance calls as well. Both TCPs support both schemes.

R1.5 protocols use two signaling bits (A and B) per direction to control the state of calls. Line signaling is a combination of signaling bit variations and in-band tones.

Register signaling is usually performed by acknowledged MF tones. This means that the outbound equipment plays a forward tone (representing one of the address digits), and the inbound equipment requests the next tone by playing a backward MF tone. Both tones are timed, not compelled.

However, it is possible for the outbound to be requested to switch to decadic pulse dialing during setup of a call, since not all switches in the Russian networks are equipped with MF tone detectors.

MF-pulse shuttle protocol is the default register signaling for both inbound and outbound protocols and can be combined or replaced with other types of register signaling.

R15 editable parameters

To program the R15 inbound and outbound TCPs to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_R15. You can modify parameters that program TCP/host interaction, that configure unregulated features, or that configure features that can change from switch to switch within the same network.

The following table describes NCC.X.ADI_R15 parameters (within the parameter category NCC.X.ADI_R15) that you can modify:

Field	Type/ Unit	Default	Description
DIDnumber	count	7	Inbound. Specifies the number of incoming DID digits to expect.
ANInumber	count	8	Inbound. Specifies the number of ANI digits to expect. If this parameter is set to 0, then the inbound protocol does not attempt to request the ANIs. If this parameter is set to any other number, the inbound protocol requests the ANIs, and receives as many as the outbound side will provide.
decadicsignalmethod	mask	0x0	Set to 1 to do decadic dialing (for both inbound and outbound protocols).
longdistanceinbound	mask	0x0	Set to 1 for long distance inbound protocol.
mustsendANI	mask	0x0	Set to 1 to make the transmission of ANIs mandatory (relevant to the outbound protocol).
mustgetANI	mask	0x0	Set to 1 to make the reception of ANIs mandatory (relevant to the inbound protocol).
waitingplaybusy	mask	0x1	Set to 1 to play busy on timeout.
waitingplayreorder	mask	0x0	Set to 1 to play fast busy on timeout.
waitingplaysilence	mask	0x0	Set to 1 to play silence on timeout.
longdistancedecadic	mask	0x0	Reserved.
switchtoDecadic	mask	0x0	Reserved.
sendANIsingledigit	mask	0x0	Set to 1 to enable the detection of ANIs one at a time. The information will be presented in the form of an NCCEVN_PROTOCOL_EVENT with a value R15_ANI_DIGIT. The value of the digit may be retrieved by looking at the size field.
firstcommand	count	1	Inbound. First command for inbound protocol. 1 - Send first digit. 2 - Send next digit. 3 - Send previous digit. If the value is set to 2 or 3, make sure that DIDnumber is set to a correct value.

Field	Type/ Unit	Default	Description
anirequestattempts	count	3	Inbound. The parameter specifies the number of attempts to obtain ANIs. If the parameter is set to 0, no attempts will be made. When reception of ANIs is mandatory (bit 0x8 in optionflags is set) and no ANIs are received after the first attempt, this parameter can be used to perform additional ANI requests before clearing back.
dialstartposition	count	4	Outbound. Specifies the starting position within a dial string. For example, when the first request from the inbound side, defined by NCC.X.ADI_R15.firstcommand, is B2 (send next digit) or B3 (send the previous digit), the first DID that is presented by the outbound side is located in the NCC.X.ADI_R15.dialstartposition position.

Refer to *R15 non-editable parameters* on page 163 for more information.

R15 non-editable parameters

The following NCC.X.ADI_R15 parameters are country or network specific and cannot be modified.

Caution:	Most of the parameters that follow are signaling specific: changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

Field	Type/ Unit	Default	Description
qualtime	ms	20	Qualification time for bit changes.
waitbegintime	ms	60	Delay before starting to play the forward and backward tones.
Outbound timers			
seizetime	ms	400	Maximum time to receive the seizure acknowledge.
waitbacksignaltime	ms	4000	Maximum time to receive a backward request.
pausefrstdigittime	ms	300	Initial wait before dialing the first decadic pulse.
interdigittime	ms	750	Time between two trains of pulses while dialing with decadic pulses.
confirmanswertime	ms	275	Timeout for differentiating answer versus ANI request that is the same line code but accompanied by a 500 Hz tone.
Inbound timers			
waitfrwdsignaltime	ms	350	Maximum time to receive a forward signal.
waitfrwddeksignaltime	ms	40000	Maximum time to receive a decadic digit.
inbinterdigittime	ms	400	Time to wait before deciding that a train of decadic pulses is over.

Field	Type/ Unit	Default	Description
Inbound ANI detector timers			
anitonetimeout	ms	100	Time to wait before deciding that the transmission of ANIs is over.
anirequesttimeout	ms	1000	Timeout to get the first ANI.
answersignalontime	ms	500	Duration of line signal AB-10 (answer) when requesting ANIs.
requestdelaytime	ms	200	Delay between A-12 and the ANI request line signal AB-10.
tonedelaytime	ms	230	Delay between signaling answer during the ANI request and sending the 500 Hz tone. This value has been optimized for use within the Russian network. It should be decreased for back-to-back testing.
Dialing control			
toneontime	ms	45	Duration of the MF tone used to convey DID information (backward and forward).
toneofftime	ms	40	Silence between the MF tones used to convey DID information (backward and forward). Also used for echo cancellation.
pulseontime	ms	50	Outbound: Time a pulse should be ON while dialing with decadic pulses.
pulseofftime	ms	50	Outbound: Time a pulse should be OFF while dialing with decadic pulses.
anitoneontime	ms	40	Outbound: Duration of the MF tone used to convey ANI information.
toneslevel	IDU	315	Amplitude of MF (call setup) tones (forward and backward).
anirequestontime	ms	120	Duration of the 500 Hz tone during an ANI request.

The following parameters are reserved for NMS internal use:

- alarmsonqualtime
- alarmsoffqualtime

Refer to *R15 editable parameters* on page 162 for more information.

R15 and NCC service call control

When applications perform NCC service call control with the R15 TCP, they can receive digits in the following ways:

- All at once
- One at a time

Receiving digits all at once

When the application receives the NCCEVN_INCOMING_CALL event, not all information regarding the inbound call is available. For local calls, the missing information is the caller's category and ANI digits. This is because the R1.5 local outbound protocol sends the category and ANI digits only after the inbound party has accepted the call. Thus the NCC_CALL_STATUS has only one relevant field that is filled if the application calls **nccGetCallStatus** after an NCCEVN_INCOMING_CALL event:

Field	Description
calledaddr	Called number. Also referred to as the direct inward dial (DID) number.

If the application accepts the call, the TCP collects the caller's category and ANI digits. Once they are available, the application can receive an NCCEVN_CALL_STATUS_UPDATE with a value of NCC_CALL_STATUS_CALLINGADDR, or NCCEVN_EXTENDED_CALL_STATUS_UPDATE with a value of NCC_EXTENDED_CALL_STATUS_CATEGORY.

Note: The reception of this event must be explicitly enabled before starting the protocol, by setting the NCC_REPORT_STATUSINFO bit in the NCC.START.eventmask parameter.

A subsequent call to **nccGetCallStatus** returns a new field: callingaddr. This field indicates the calling number (if available), also referred to as the automatic number identification (ANI) number.

Another call to **nccGetExtendedCallStatus** yields the following new field:

Field	Description
usercategory	Calling party category (normal subscriber, operator, maintenance equipment).

Two NCC.X.ADI_R15 parameters affect the way the R15 TCPs accept and process digits:

Parameter	Description
DIDnumber	Number of direct inward dial (DID) digits the TCP should expect from the calling party. Default is 7.
ANInumber	Number of ANI and category digits the TCP should expect from the calling party. For local inbound calls, if the parameter is set to 0, the ANI request is not attempted; otherwise the TCP retrieves all the digits the calling party sends. This parameter is not relevant for long distance inbound calls.

Receiving digits one at a time

The R15 TCP sends the incoming DID digits to the application one at a time in the following sequence:

$d_1 \ldots d_n$

where ***n*** is determined by the NCC.X.ADI_R15.DIDnumber parameter.

If the application sets the NCC.X.ADI_sendanisingledigit parameter, the TCP also provides the ANI digits and the caller category as they arrive. This happens after the call is accepted by the application. Due to the working of the protocol, ANI digits may be:

- Reversed (last digit of the calling number first in sequence)
- Presented more than once, since the switch sends the category and ANI digits in a fast spill which can be repeated several times

The size field of the event structure contains the actual digit value.

22 Wink start protocols (digital and analog)

WNK signaling

The wink start protocol (WNK) family includes protocols used on T1 in the USA, Hong Kong, and Taiwan, and protocols used on E1 elsewhere. The protocol uses one-bit signaling (or presence or absence of current in the analog case), and owes its name to the wink (brief presence of current or variation of the signaling bit) that the inbound side uses to indicate readiness to receive address signaling. Register signaling is performed by in-band DTMF or MF tones, or by out-of-band decadic pulses.

The international wink start (IWK), DID, and OGT protocols are incorporated into the wink start protocol.

The wink start protocol is symmetrical (same implementation from the network or from customer premises equipment).

The signaling channel supporting the WNK line signaling protocol is referred to as A_f in the forward direction, and A_b in the backward direction. The forward channel indicates the condition of the outbound switch equipment and reflects the condition of the calling party's line. The backward channel indicates the condition of the called party's line (the inbound equipment).

On T1 trunks, the other bits in either direction usually follow the state of the A bit. On E1 trunks, the value of the B, C, and D bits is usually 1, 0, 1 respectively.

In the U.S. and Taiwan, the idle code is A=0.

In Hong Kong, two variations are possible in the Hong Kong Telecom network:

- Pulse on busy (idle code is A=0)
- Pulse on idle (idle code is A=1)

The two variations execute call setup in exactly the same way, except that all bit changes are opposite. The WNK TCP parameter optionflags, bit 1, specifies which variation to use.

The line signaling for a typical call is described in the following table. The table represents the pulse on busy variation:

State	Outbound A_f	Direction	Inbound A_b
Idle	0	← →	0
Seizure	1	→	0
Seizure acknowledge	1	←	0-1-0 (wink)
The outbound side starts to send the address information using DTMF tones, MF tones, or decadic pulses. If the method is decadic pulses, the A_f bit is switched off (pulse on) and on (pulse off) repeatedly to signal the digits.			
Register signaling: digit spill	DTMF or MF	→	0
Register signaling: pulse dial	0 pulse on	→	0
	1 pulse off	→	0
All the address information has been transferred. The inbound side accepts or rejects the call by playing the ring or the busy tone on the voice path. If the call is rejected, the outbound side switches back to signaling A = 0 (idle), thus clearing the line.			
Clear forward and idle	0	→	0
If the call is accepted, the inbound side answers the call by flipping both backward bits to 1.			
Answer - conversation state	1	←	1
Depending on which side hangs up the call first, a clear back signal or a clear forward signal is generated. Idle follows.			
Inbound hangs up first: Clear back	1	←	0
Outbound hangs up first: Clear forward	0	→	0 or 1
Idle	0	← →	0

In analog variations the digital bit signaling is translated into E & M or DID analog signaling by the line interface circuitry on the board.

In U.S. implementations, the wink start protocol can transfer ANI (caller ID) information in addition to DID digits (direct inward dialing - the called address). A separator tone is used to distinguish between DID and ANI digits in the DTMF digit spill. Usually the separator tone is an * (asterisk) (941+1209 Hz). The parameter NCC.X.ADI_WNK.anididtone (see following table) determines the TCP's behavior with respect to ANI digits.

Taiwan and Hong Kong do not use ANI digits.

WNK parameters

To program the WNK TCP to operate within different countries and networks, modify the TCP-specific parameters, stored within the parameter category NCC.X.ADI_WNK. You can modify parameters that program TCP/host interaction, configure unregulated features, or configure features that can change from switch to switch within the same network. You can freely edit these parameters to suit your implementation.

Note: The international wink start protocol (IWK) is now incorporated into the wink start protocol. If you were using the DID protocol, set the parameter trunkdirection to TRUNK_INBOUND to use the wink start protocol. If you were using the OGT protocol, set the parameter trunkdirection to TRUNK_OUTBOUND to use the wink start protocol.

Caution:	Most of the parameters that follow are signaling specific. Changing their value invalidates any approval certificate for the used board and can cause the board to malfunction. These parameters are described here for reference purposes only.

The following table describes NCC.X.ADI_WNK parameters (within the parameter category NCC.X.ADI_WNK):

Field	Type/ Unit	Default	Description
numdigits	count	3	Relevant to inbound protocol. Specifies the number of incoming digits to expect.
variabledigits	mask	0x1	Determines what to do if a timeout occurs during digit reception: 0 - Reject the call. 1 - Notify the host of an inbound call
idlebits	mask	0x0	Idle code mode. 0 - Setting the A bit to 0 means idle, 1 means seized. 1 - Setting the A bit to 0 means seized, 1 means idle.
trunkdirection	mask	0x0	Trunk direction: 0 - Bidirectional (default) 1 - Inbound 2 - Outbound
playcleardown	mask	0x0	If 1, play cleardown tone while hanging up (inbound).
defaultrejecttone	count	2	Tone to play if NCC.START.waitforPCtime expires: 1 - Ring 2 - Busy 3 - Fast busy (reorder)
transfersupport	mask	0x1	Flag to select whether PBX transfer is allowed: 0 - Disables transfer commands 1 - Enables transfer commands
qualtime	ms	30	Qualification time for signaling bit going to ON during register signaling phase of call setup.
compelledKP	mask	0x0	Register signaling. If 1, prefix with/expect compelled KP tone. Used in Taiwan.
immediatestart	mask	0x0	Line signaling. If 1, inbound doesn't send a wink (immediate start).

Field	Type/ Unit	Default	Description
signalingmethod	count	0	Determines tones register signaling is performed with: 0 - DTMF 1 - MF 2 - Decadic signaling
receiveKPST	mask	0x1	When register signaling is performed with MFs: 0 - Inbound does not look for KP and ST tones. 1 - Inbound looks for KP and ST tones.
noSTreceptionOK	mask	0x0	Determines whether the TCP will accept signaling if the ST tone does not arrive. 0 - Does not accept signaling. 1 - Accepts signaling.
sendKPST	mask	0x1	(Outbound only) determines whether or not to send KP and ST tones when dialing with MF tones: 0 - Do not send KP and ST tones. 1 - Send KP and ST tones.
anibeforedid	ms	0x0	Determines whether the ANI digits come before the DID digits. 0 - DID digits come before the ANI digits. 1 - ANI digits come before the DID digits.
anididtone	mask	0x0	For DTMF, tone that specifies a separator between DID and ANI digits. Set to 0x2A for * (asterisk). Set to 0 for no separator. For MF: # (pound sign) - Pauses between DNIS and ANI. * (asterisk) - Waits for wink between DNIS and ANI. @ (at sign) - Waits for answer between DNIS and ANI.
endofdigitstone	mask	0x0	Tone that specifies the end of digits. Set to 0x23 for # (pound sign).
winktime	ms	210	Inbound: Specifies the duration of the wink used by the TCP to signal seizure acknowledgment.
prewinktime	ms	210	Inbound: Time to wait before sending the wink that acknowledges the seizure.
wait1stdigittime	ms	7000	Inbound: Time to wait after seizure acknowledge for the first digit to arrive.
waitfordigitstime	ms	2000	Inbound: Time to wait after each digit arrives for the next digit.
winkwaittime	ms	10000	Outbound: Time to wait for seizure acknowledgement after seizing the line. Maximum time to wait for the far end to wink. Set to 0 if no wink is expected (immediate start).
minwinktime	ms	100	Outbound: Minimum duration of seizure acknowledgment wink.
maxwinktime	ms	4900	Outbound: Maximum duration of seizure acknowledgment wink.
predialtime	ms	70	Outbound: Time to wait after the wink to start dialing.

Field	Type/ Unit	Default	Description
mfkpsttimeon	ms	80	Outbound: Duration of the KP and ST tones, if transmitted.
mfkpsttimeoff	ms	80	Outbound: Duration of the silence after the KP and ST tones.
mfkpstampl	IDU	352	Outbound: Amplitude of the KP and ST tones.
releaseguardtime	ms	1000	Outbound: Time after an outbound call in which the TCP will not place another call.
assumenewdigittime	ms	0	Inbound: There are some switches that leave too short a time between MF tones to detect the silence. This parameter adjusts the minimum amount of silence that must occur between consecutive MF tones before the TCP assumes they represent different digits. Set to slightly more than the full duration of an MF digit cycle (tone on + off).
connectbacktime	ms	100	Time to wait after sending transfer back hookflash if the PBX is playing busy tone.
xferstring	string[6]	!;	Prefix dial string for call transfer. The string is dialed before dialing the number, where: ; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
connstring	string[6]	!	String for transfer back to the connected state with the first call. It is dialed if a call transfer fails, where: !; (semicolon) - Wait for precise dial tone . (period) - Insert long pause in dialing , (comma) - Insert short pause in dialing ! (exclamation point) - Flash hook P - Switch to pulse dialing T - Switch to DTMF dialing M - Switch to MF dialing
BCD_BitFlag	mask	0	Controls behavior of the B, C, and D bits: 000 - BCD bits follow the A bit (default). Typical on T1 trunks. 001 - 111 - BCD bit value. 101 is typical on E1 trunks.
KP_Reset	mask	0	Specifies whether or not to reset the DNIS string if a KP tone is received in the middle of the string: 0 - Do not reset the string (default). 1 - Reset the string to no digits collected.
Pass_KP_ST	mask	0	Specifies whether or not to return KP and ST tones to the application with the other digits in the DID string: 0 - Do not return KP and ST tones (default). 1 - Return KP and ST tones.
MLPP	mask	0	Preemption control.
metering_enabled	mask	0	0 - Disables metering pulse detection. 1 - Enables metering pulse detection.

WNK and NCC service call control

When applications receive inbound calls using NCC service call control with the WNK TCP, they can process digits in one of the following ways:

Method of processing digits	Description
Receiving digits all at once	With wink start-derived TCPs, after NCCEVN_INCOMING_CALL is received, the calledaddr field in the NCC_CALL_STATUS structure usually contains all received digits. The callingaddr, usercategory and tollcategory fields are usually NULL. The parameter NCC.X.ADI_WNK.numdigits determines the number of digits the TCP should expect from the calling party (including ANI digits and the * (asterisk), when expecting ANI). The default is 3. **Note:** With the WNK0 TCP digital two-way wink start, if the parameter NCC.X.ADI_WNK.aniidtone is set correctly, any ANI digits in the digit string are presented to the application in the callingaddr field.
Receiving digits one at a time	To receive digits one at a time, make sure the Ncc.Start.OverlappedReceiving parameter is set. In general, digits are presented in the order in which they arrive. If ANI are present, the DTMF tones * (asterisk) and # (number sign) are also present in the digits received by the TCP. Only the * (asterisk) (separator between ANI and DID) is passed to the application though, not the # (number sign), that signals the end of the digit string (ST tone). When receiving digits one at a time, the application must know the order of the fields in the digit string (ANI or DID first).

23 Supported caller ID formats

BellCore caller ID data

The following table describes the caller ID format for BellCore:

Parameter	Values	Type	Length	Field
Calling line number	Calling number identity	0x02	up to 30 up to 20	**Receive:** NCC_CALL_STATUS.callingaddr **Send:** **nccPlaceCall** (callingaddr)
Reason for absence of number	O - Unavailable P - Private	0x04	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.ANIpresentation **Send:** CAS_PLACECALL_EXT.ANIpresentation
Calling name	Calling name	0x07	up to 30 up to 15	**Receive:** NCC_CALL_STATUS.callingname **Send:** CAS_PLACECALL_EXT.callingname
Reason for absence of name	O - Unavailable P - Private	0x08	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.NAMEpresentation **Send:** CAS_PLACECALL_EXT.ANIpresentation
Called number (DDN)	Dialed number or dialable directory number (DDN)	0x03	up to 30 up to 20	**Receive:** NCC_CALL_STATUS.calledaddr **Send:** **nccPlaceCall** (calledaddr)
Call qualifier	L -Long distance	0x06	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.tollcategory **Send:** CAS_PLACECALL_EXT.tollcategory
Reason for redirection	0x00 - Unconditional 0x01 - Busy 0x02 - Unanswered	0x05	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.redirectingreason **Send:** CAS_PLACECALL_EXT.redirectingreason
Visual indicator	Message waiting indicator	0x0B	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.MWIndicator
Date/time	MMDDhhmm	0x01	8	**Receive:** NCC_CAS_EXT_CALL_STATUS.datetime **Send:** CAS_PLACECALL_EXT.datetime

ETSI (France) caller ID data

The following table describes the caller ID format for ETSI (France):

Parameter	Values	Type	Length	Field
Calling line number	Calling number identity	0x02	up to 30 up to 20	**Receive:** NCC_CALL_STATUS.callingaddr **Send:** **nccPlaceCall** (callingaddr)
Reason for absence of number	O - Unavailable P - Private	0x04	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.ANIpresentation **Send:** CAS_PLACECALL_EXT.ANIpresentation
Calling name	Calling name	0x07	up to 30 up to 31	**Receive:** NCC_CALL_STATUS.callingname **Send:** CAS_PLACECALL_EXT.callingname
Reason for absence of name	O - Unavailable P - Private	0x08	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.NAMEpresentation **Send:** CAS_PLACECALL_EXT.ANIpresentation
Called number (DDN)	Dialed number or dialable directory number (DDN)	0x03	up to 30 up to 31	**Receive:** NCC_CALL_STATUS.calledaddr **Send:** **nccPlaceCall** (calledaddr)
Type of forwarded call	0x00 - Unavailable or unknown 0x01 - Forward on busy 0x02 - Forward on no reply 0x03 - Unconditional forward 0x04 - Deflected call (after alerting) 0x05 - Deflected call (immediate) 0x06 - Forward on inability to reach mobile subscriber	0x15	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.redirectingreason **Send:** CAS_PLACECALL_EXT.redirectingreason

Parameter	Values	Type	Length	Field
Type of user calling	0x00 - Origination unknown or unavailable 0x01 - Voice 0x02 - Text 0x03 - VPN (virtual private network) 0x04 - Mobile phone 0x05 - Mobile phone + VPN 0x06 - Fax 0x07 - Video 0x08 - Email 0x09 - Operator 0x0A - Ordinary calling subscriber 0x0B - Calling subscriber with priority 0x0C - Data call 0x0D - Test call 0x0E - Telemetric call 0x0F - Pay phone	0x16	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.usercategory **Send:** CAS_PLACECALL_EXT.usercategory
Redirecting number	Last redirecting party	0x1A	up to 30 up to 20	**Receive:** NCC_CAS_EXT_CALL_STATUS.redirectingaddr **Send:** CAS_PLACECALL_EXT.redirectingaddr
Call type	0x01 - Voice 0x02 - Ringback when free 0x03 - Calling name delivery 0x04 - Call return 0x05 -Alarm 0x06 - Download function 0x07 - Reverse charge 0x10 - External 0x11 - Internal 0x50 - Monitoring 0x81 - Message waiting	0x11	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.tollcategory **Send:** CAS_PLACECALL_EXT.tollcategory
Network operator extended information	***CCCNNNNVVV*** *Where*: ***C*** = Country ***N*** = Network ***V*** = Version	0xE0	10	**Receive:** NCC_CAS_EXT_CALL_STATUS.carrierid **Send:** CAS_PLACECALL_EXT.carrierid

Parameter	Values	Type	Length	Field
Visual indicator	Message waiting indicator	0x0B	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.MWIndicator **Send:** CAS_PLACECALL_EXT.MWIndicator
Date/time	MMDDhhmm	0x01	8	**Receive:** NCC_CAS_EXT_CALL_STATUS.datetime **Send:** CAS_PLACECALL_EXT.datetime

NTT (Japan) caller ID data

The following table describes the caller ID format for NTT (Japan):

Parameter	Values	Type	Length	Field
Calling line number	Calling number identity	0x02	up to 30	**Receive:** NCC_CALL_STATUS.callingaddr
Reason for absence of number	O - Unavailable P - Private C - Coin/card public telephone origin S - Service status	0x04	1	**Receive:** NCC_CALL_STATUS.ANIpresentation
Calling name	Calling name	0x07	up to 30	**Receive:** NCC_CALL_STATUS.callingname
Reason for absence of name	O - Unavailable P - Private C - Coin/card public telephone origin S - Service status	0x08	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.NAMEpresentation
Called number (DDN)	The number of called party, including DDI number	0x09	up to 30	**Receive:** NCC_CALL_STATUS.calledaddr
Date/time	MMDDhhmm	0x01	8	**Receive:** NCC_CAS_EXT_CALL_STATUS.datetime
Redirecting number	The last redirecting party	0x0B	up to 30	**Receive:** NCC_CAS_EXT_CALL_STATUS.redirectingaddr
Reason for redirection	0x00 - Undefined 0x01 - Busy 0x02 - Unanswered 0x15 - Unconditional	0x0B	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.redirectingreason

Parameter	Values	Type	Length	Field
Calling number extended	Calling user type. 0x***TP*** *where*: ***T*** = Type of number. Values: 0 - Unknown 1 - International 2 - Domestic 3 - Network 4 - Local 6 - Abbreviated ***P*** = Numbering plan. Values: 0 - Unknown 1 - ISDN 3 - Data 4 - Telex 8 - Domestic 9 - Private	0x21	1	**Receive:** NCC_CAS_EXT_CALL_STATUS.usercategory
Public message		0x24	up to 30	**Receive:** NCC_CAS_EXT_CALL_STATUS.carrierID

Caller ID generation with the STA protocol

A call originated on an AG 2000 subscriber loop board that is running the STA protocol can automatically transmit an FSK caller ID sequence during the ring cycle.

The *adsix.m54* DSP file (FSK transmitter) must be loaded on the board.

The following table describes the values for the lower 3 bits of NCC.X.ADI_STA.cidsupport:

Value	Description
0x00	Disable caller ID generation (default).
0x01	Generate Bellcore data format caller ID.
0x03	Generate ETSI data format caller ID.

Bits 4 and 5 control when the caller ID is generated. The following table describes the values for bit 4 and bit 5:

Value	Description
0x00	First ring is normal full cycle, caller ID follows.
0x10	First ring is abbreviated single ring, caller ID follows.
0x20	Caller ID alerting tone is transmitted, followed by caller ID, followed by normal full length ring cycles.

The information that is transmitted comes from **nccPlaceCall** parameters and extended arguments in CAS_PLACECALL_EXT. Parameters set to 0 will not be transmitted.

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